SOIL SURVEY OF

Noble County, Indiana

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Purdue University Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1968–73. Soil names and descriptions were approved in 1974. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1974. This survey was made cooperatively by the Soil Conservation Service and the Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the Noble County Soil and Water Conservation District. Partial funding of this soil survey was provided by Noble County Soil and Water Conservation District and approved by the County Commissioners and County Council.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Noble County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetical order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the woodland group and tree and shrub group to which the soil has been assigned.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and woodland groups.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, commercial buildings, and for waste disposal facilities in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in Noble County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Environmental Factors Affecting Soil Use."

Cover: Diversion terrace helps control erosion on Morley silty clay loam on the knoll and ponding on Houghton muck in the depression.

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SOIL SURVEY OF NOBLE COUNTY, INDIANA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE,
IN COOPERATION WITH THE PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

NOBLE COUNTY is in the northeastern part of Indiana (fig. 1). The county is nearly rectangular in shape and covers an area of about 410 square miles or 262,400 acres. Albion, the county seat, is in the central part of the county.

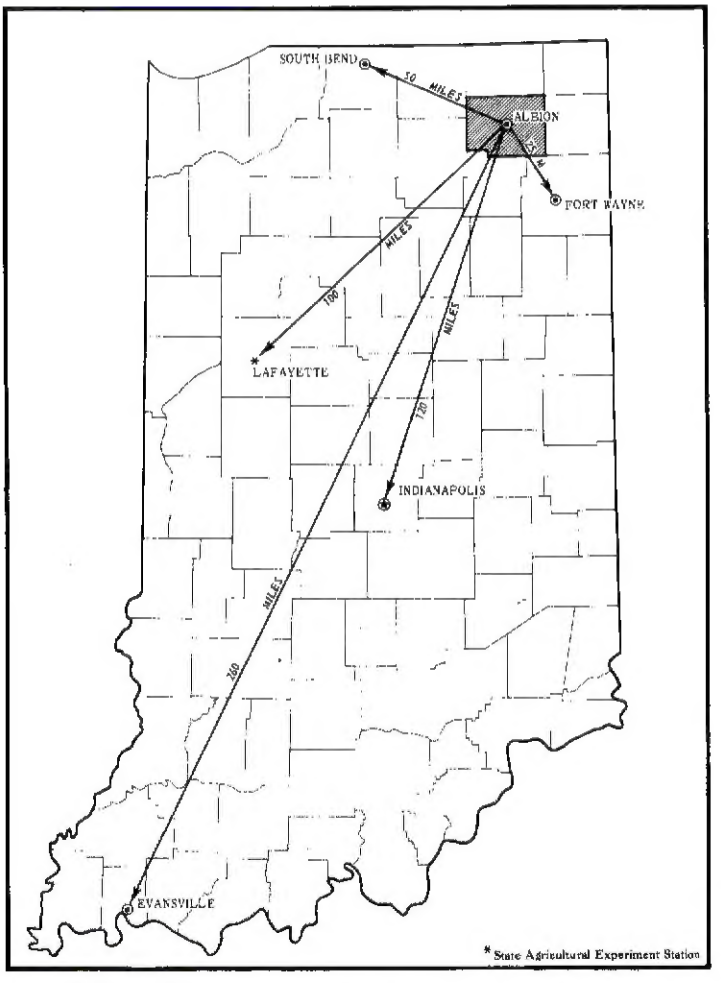

Figure 1.—Location of Noble County in Indiana.

The population of Noble County was 31,382 in 1970. Most of the people make their living from farming or work at factories in local towns or in nearby Fort Wayne. In 1969, according to the U.S. Census of Agriculture, about 227,008 acres was farmed. Of this acreage, about 33 percent was used for cultivated crops, 45 percent for other crops, 10 percent for pasture, and 12 percent for woodland. Corn, soybeans, and wheat are the main crops. Cash-grain and general farming are the main enterprises. Many areas, particularly near Kendallville, Ligonier, and Albion and around lakes, have been developed for housing and industry during the past few years. This trend is expected to continue.

The soils of Noble County formed mainly in glacial till, outwash, alluvium, and organic material. Soils that formed in till are well drained to very poorly drained and are mainly medium textured or moderately fine textured. Soils that formed in outwash are mainly medium textured or moderately coarse textured and are very poorly drained to excessively drained. Alluvial soils on flood plains are medium textured and somewhat poorly drained. Organic soils, which are mainly muck and peat, are very poorly drained.

Erosion is the main concern on the sloping soils on uplands and terraces. Drainage is needed in farmed areas of the nearly level, somewhat poorly drained, poorly drained, or very poorly drained soils that formed in outwash, till, or organic material. Irrigation is needed on the somewhat excessively drained or excessively drained soils that formed in outwash.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Noble County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and nature of streams; the kinds of native plants or crops; the kinds of rock, if any; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material that has not been

changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Miami and Fox, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miami loam, 2 to 6 percent slopes, eroded, is one of several phases within the Miami series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent because it is not practical to show on such a map all the small scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units—soil complexes and undifferentiated groups—are shown on the soil map of Noble County.

A soil complex consists of areas of two or more soils so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Fox-Casco sandy loams, 12 to 18 percent slopes, eroded, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Rawson, Morley, and Miami loams, 2 to 6 percent slopes, eroded, is an example of an undifferentiated group in Noble County.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Lake borders is a land type in this survey.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing medium for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this failure to slow permeability or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a given kind of soil, and they relate this failure to a high shrink-swell potential. Thus, they use observation and knowledge of soil properties, together with available research data, to predict the limitations or suitability of a soil for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their study and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Noble County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful, general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community

developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eight soil associations in this survey have been grouped into general kinds of landscapes for broad, interpretative purposes. Each of the broad groups and the soil associations are described on the following pages.

Soil associations and delineations on the general soil map in this soil survey do not fully agree with those on the general soil maps for adjacent counties published at a different date. Differences on the maps are a result of improvements in the classification of soils, particularly in the modifications or refinements in soil series concepts. They can also be the result of the range in slope that is permitted within associations in different surveys. In addition, more precise and detailed maps are needed because the use of the general soil maps has expanded in recent years.

Moderately Deep or Deep, Well Drained to Very Poorly Drained, Nearly Level to Moderately Steep Mineral Soils That Have a Moderately Coarse Textured to Fine Textured Subsoil; on Uplands or Outwash Plains

The associations in this group are dominated by soils that are well drained to very poorly drained and nearly level to moderately steep. They make up about 85 percent of the county. They are used chiefly for corn, soybeans, and wheat and for grasses and legumes for hay and pasture. Strongly sloping and moderately steep areas are used mainly for pasture or woodland. The limitation for septic tank absorption fields is slight to severe.

1. Warsaw-Parr association

Well drained, nearly level soils that have a dominantly moderately fine textured subsoil and are moderately deep and deep over sand and gravel; on outwash plains and uplands

This association is gently undulating on plains where there are many well drained, shallow potholes and closed, slightly depressional areas. The soils formed under prairie grasses and scattered hardwood trees. The association makes up about 1 percent of the county. It is about 60 percent Warsaw soils, 30 percent Parr soils, and 10 percent soils of minor extent.

Warsaw soils are moderately deep over loose and gravelly sand. They are on outwash plains. The surface layer is about 14 inches of very dark brown loam. The subsoil is about 21 inches thick. In sequence from the top, it is 3 inches of friable, dark brown loam; 12 inches of firm, brown sandy clay loam; 4 inches of firm, brown sandy clay loam; 4 inches of friable, brown loam; and 2 inches of firm, very dark brown gravelly sandy clay loam. The substratum to a depth of about 60 inches is brown, stratified sand and gravelly sand.

Parr soils are deep. They are on flats and in closed, slightly depressional areas in the upland. Depressional areas are narrow and elongated in shape. The surface layer is 12 inches of very dark grayish brown loam. The subsoil is about 30 inches thick. In sequence from the top, it is 5 inches of firm, dark yellowish brown light clay loam; 12 inches of firm, dark yellowish brown clay loam; 7 inches of firm, yellowish brown clay loam; and 6 inches of friable, brown heavy loam. The upper part of the substratum is about 54 inches of pale brown loam and the lower part is about 14 inches of yellowish brown, stratified sand and gravelly sand.

Less extensive in this association are Miami and Fox soils. The well drained Miami soils are flats, knolls, and breaks along depressions and drainageways in the upland. The well drained Fox soils are on flats, on knolls, along depressions, and along drainageways in the upland.

This association is used mostly for crops. Corn, soybeans, and wheat are the main crops. The available water capacity is moderate or high. The surface layer is high in content of organic matter.

Droughtiness is a limitation for crops on Warsaw soils. Parr soils have no limitations for crops. The limitation for septic tank absorption fields is slight on Warsaw soils and moderate on Parr soils. Warsaw soils are a source of sand and gravel.

2. Miami-Riddles-Brookston association

Well drained and very poorly drained, nearly level to moderately steep, deep soils that have a moderately fine textured subsoil; on uplands

This association is nearly level to moderately steep on knolls and along drainageways and nearly level in depressions and in drainageways. It makes up about 28 percent of the county. It is about 40 percent Miami soils, 25 percent Riddles soils, 10 percent Brookston soils, and 25 percent soils of minor extent (fig. 2).

Miami soils are well drained and are gently sloping to moderately steep. They are on knolls, ridges, and breaks along depressions and drainageways in the upland. The surface layer is 8 inches of dark grayish brown loam. The subsurface layer is 3 inches of dark grayish brown loam. The subsoil is about 27 inches thick. In sequence from the top, it is 3 inches of friable, brown light clay loam; 12 inches of firm, dark yellowish brown clay loam; 9 inches of firm, yellowish brown clay loam; and 3 inches of friable, brown light clay loam. The substratum to a depth of about 60 inches is pale brown loam.

Riddles soils are well drained and are nearly level to strongly sloping. They are on knolls and breaks along drainageways and depressions in the upland. The surface layer is 9 inches of dark grayish brown sandy loam. The subsurface layer is 5 inches of brown heavy sandy loam. The subsoil is about 38 inches thick. The upper 33 inches is firm, dark yellowish brown clay loam, and the lower 5 inches is firm, dark yellowish brown sandy clay loam. The substratum to a depth of about 72 inches is yellowish brown loam.

Brookston soils are very poorly drained and are nearly level. They are on flats and in drainageways and shallow depressions in the upland. The surface layer is 13 inches of very dark gray silt loam. The subsoil

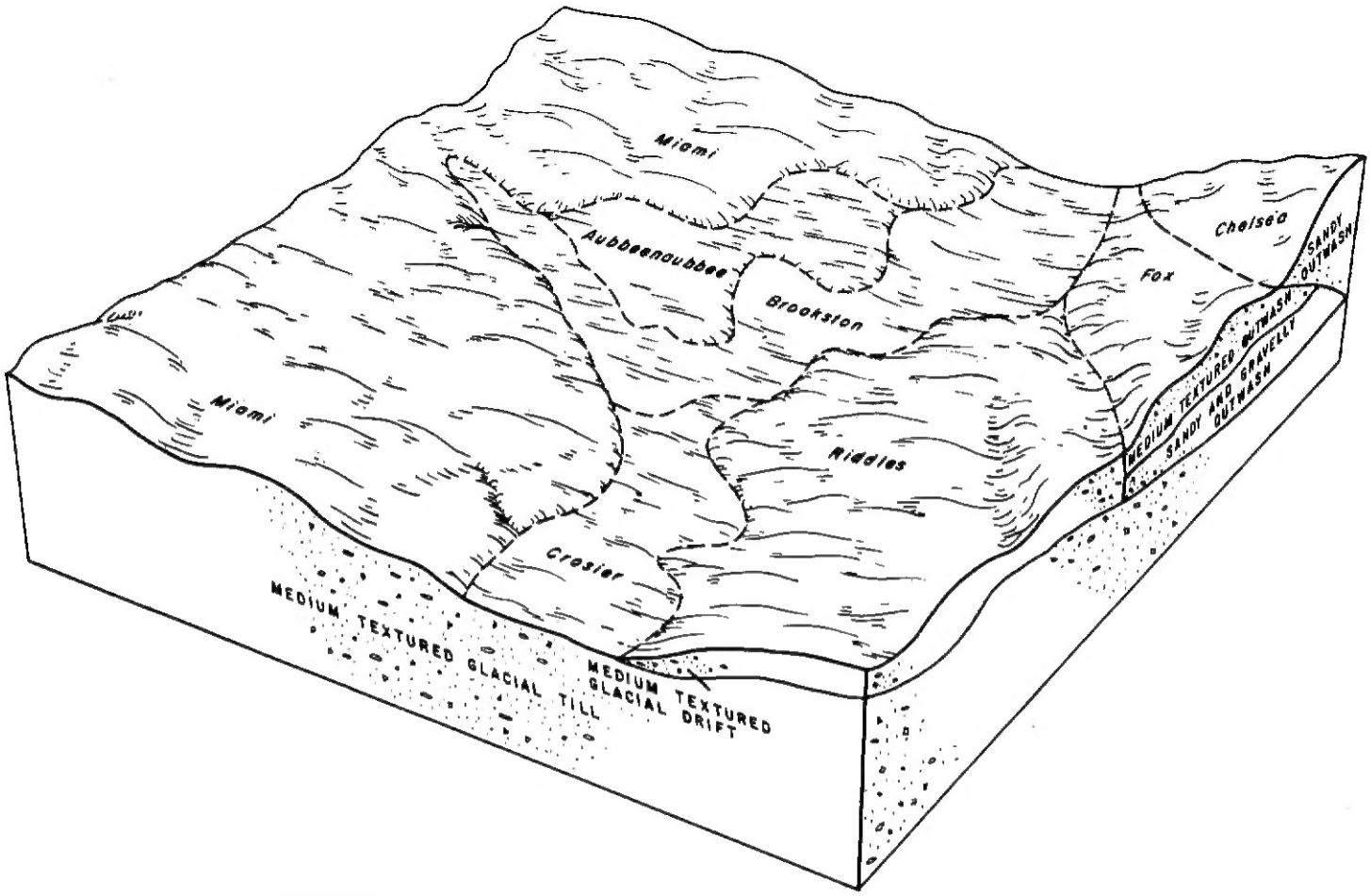

***Figure 2.*—Typical pattern of soils in the Miami-Riddles-Brookston association.**

is about 31 inches thick. In sequence from the top, it is 7 inches of firm, dark gray clay loam mottled with olive; 8 inches of firm, gray clay loam mottled with olive and light olive gray; 10 inches of firm, gray clay loam mottled with yellowish brown and olive; and 6 inches of firm, gray clay loam mottled with yellowish brown and olive. The substratum to a depth of about 60 inches is gray loam mottled with olive.

Less extensive in this association are Aubbeenaubbee, Crosier, Fox, Chelsea, and Metea soils. The somewhat poorly drained Aubbeenaubbee and Crosier soils are on flats and in drainageways in the upland. The well drained Fox soils are on knolls in the upland and along depressions or drainageways and around potholes on outwash plains. The excessively drained Chelsea soils and well drained Metea soils are on knolls in the upland.

This association is used mostly for crops and pasture. Corn, soybeans, wheat, and grasses and legumes for hay and pasture are the main crops. Most of the strongly sloping and moderately steep soils are used for pasture and woodland. The available water capacity is high. The surface layer is low in content of organic matter in Miami and Riddles soils and high in Brookston soils. Maintaining tilth and organic matter are management needs.

Erosion is a hazard on the sloping and steep Miami and Riddles soils. Wetness is a limitation on Brookston soils. The limitation for septic tank absorption fields is moderate or severe on Miami and Riddles, depending on slope, and severe on Brookston soils.

3. *Fox-Oshtemo association*

Well drained, nearly level to moderately steep soils that have a moderately coarse textured to moderately fine textured subsoil and are moderately deep and deep over sand and gravel; on outwash plains and uplands

This association is nearly level or gently sloping on outwash plains, gently sloping to moderately steep on breaks along drainageways or depressions and around potholes, and gently sloping to moderately steep on knolls (fig. 3). It makes up about 15 percent of the county. It is about 60 percent Fox soils, 15 percent Oshtemo soils, and 25 percent soils of minor extent.

Fox soils are moderately deep over sand and gravelly sand and are nearly level to moderately steep. They are on outwash plains and knolls in the upland. The surface layer is about 9 inches of dark brown sandy loam. The subsoil is moderately fine textured and extends to a depth of about 35 inches. In sequence from the top, it is 5 inches of friable, dark yellowish brown heavy sandy loam; 13 inches of firm, dark brown clay

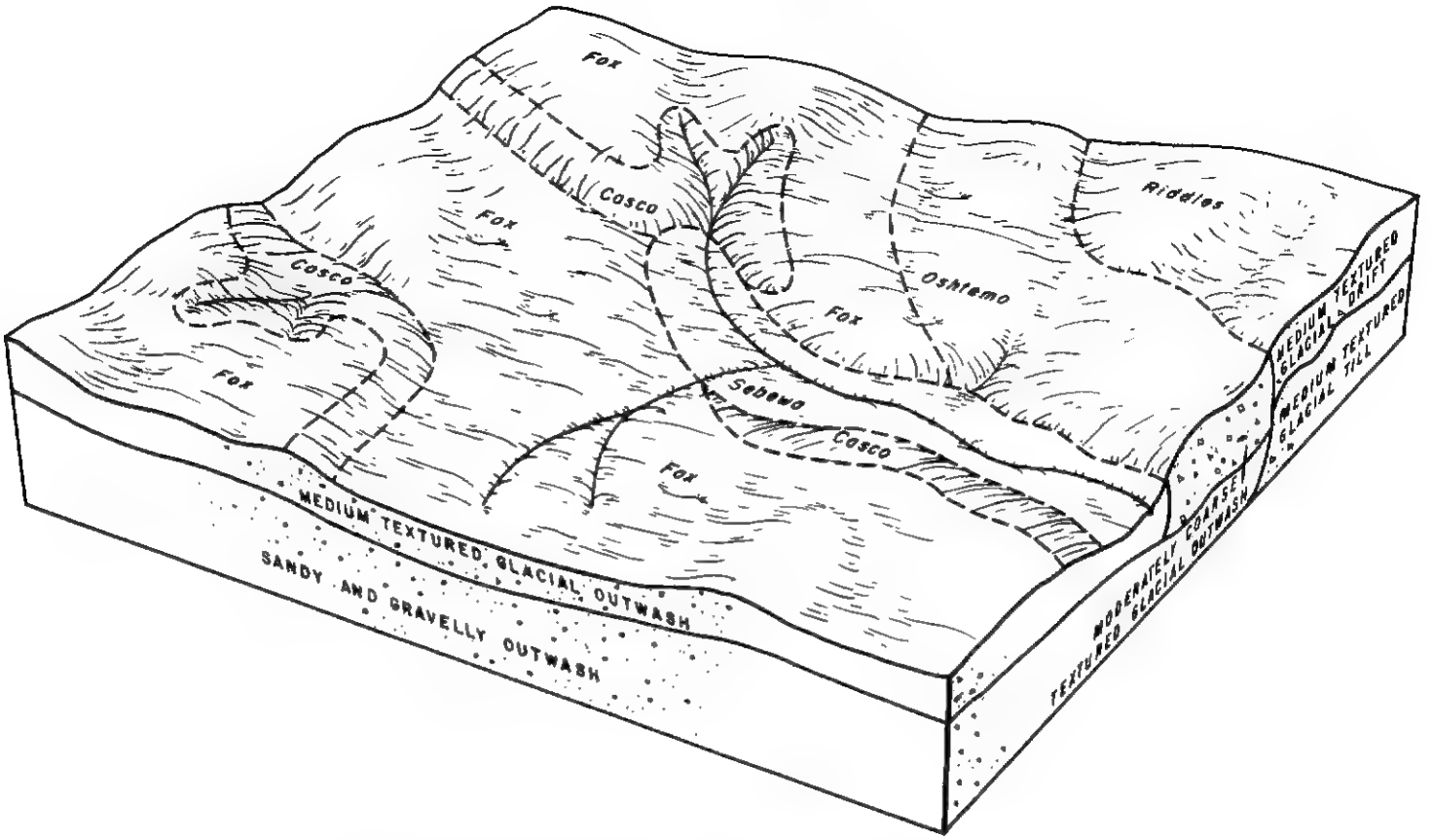

***Figure 3.*—Typical pattern of soils in the Fox-Oshtemo association.**

loam; 6 inches of firm, dark brown sandy clay loam; and 2 inches of friable, dark yellowish brown light sandy clay loam. The substratum to a depth of about 60 inches is brown stratified sand and gravelly sand.

Oshtemo soils are deep and are nearly level to moderately sloping. They are on outwash plains and knolls in the upland. The surface layer is 10 inches of dark brown loamy sand. The subsurface layer is 8 inches of brown loamy sand. The subsoil is moderately coarse textured and is about 35 inches thick. In sequence from the top, it is 5 inches of very friable dark brown sandy loam; 3 inches of friable, dark brown light sandy clay loam; and 27 inches of very friable, yellowish brown loamy sand that has 8 inches of dark brown sandy loam in strata ½ inch to 1½ inches thick. The substratum to a depth of about 60 inches is brown stratified sand and gravelly sand.

Less extensive in this association are Boyer, Casco, Homer, Riddles, and Sebewa soils. The well drained to somewhat excessively drained Casco soils and well drained Boyer soils are on knolls in the upland, in breaks along drainageways or depressions, and around potholes on outwash plains. The well drained Riddles soils are on knolls in the upland. The somewhat poorly drained Homer soils are on flats on outwash plains, and the very poorly drained Sebewa soils are in depressions or drainageways on outwash plains.

This association is used mostly for crops and pasture. Corn, soybeans, wheat, and grasses and legumes for hay and pasture are the main crops. Most of the strongly sloping and moderately steep areas are used for pasture or woodland. The available water capacity is moderate. The surface layer is moderate or low in content of organic matter. Maintaining organic matter is a management need.

Droughtiness is a limitation. Erosion is a hazard in sloping areas. The limitation for septic tank absorption fields is slight. These soils are a source of sand and gravel.

4. *Morley-Blount association*

Well drained to somewhat poorly drained, nearly level to moderately sloping, deep soils that have a fine textured and moderately fine textured subsoil; on uplands

This association is gently sloping to moderately sloping on knolls and along drainageways. The nearly level areas are on flats and in drainageways in the upland. The association makes up about 35 percent of the county. It is about 48 percent Morley soils, 12 percent Blount soils, and 40 percent soils of minor extent (fig. 4).

Morley soils are moderately well drained or well drained and are gently sloping to moderately sloping. They are on knolls and in areas along drainageways. The surface layer and subsurface layer are 9 inches of dark grayish brown silt loam. The subsoil is about 30

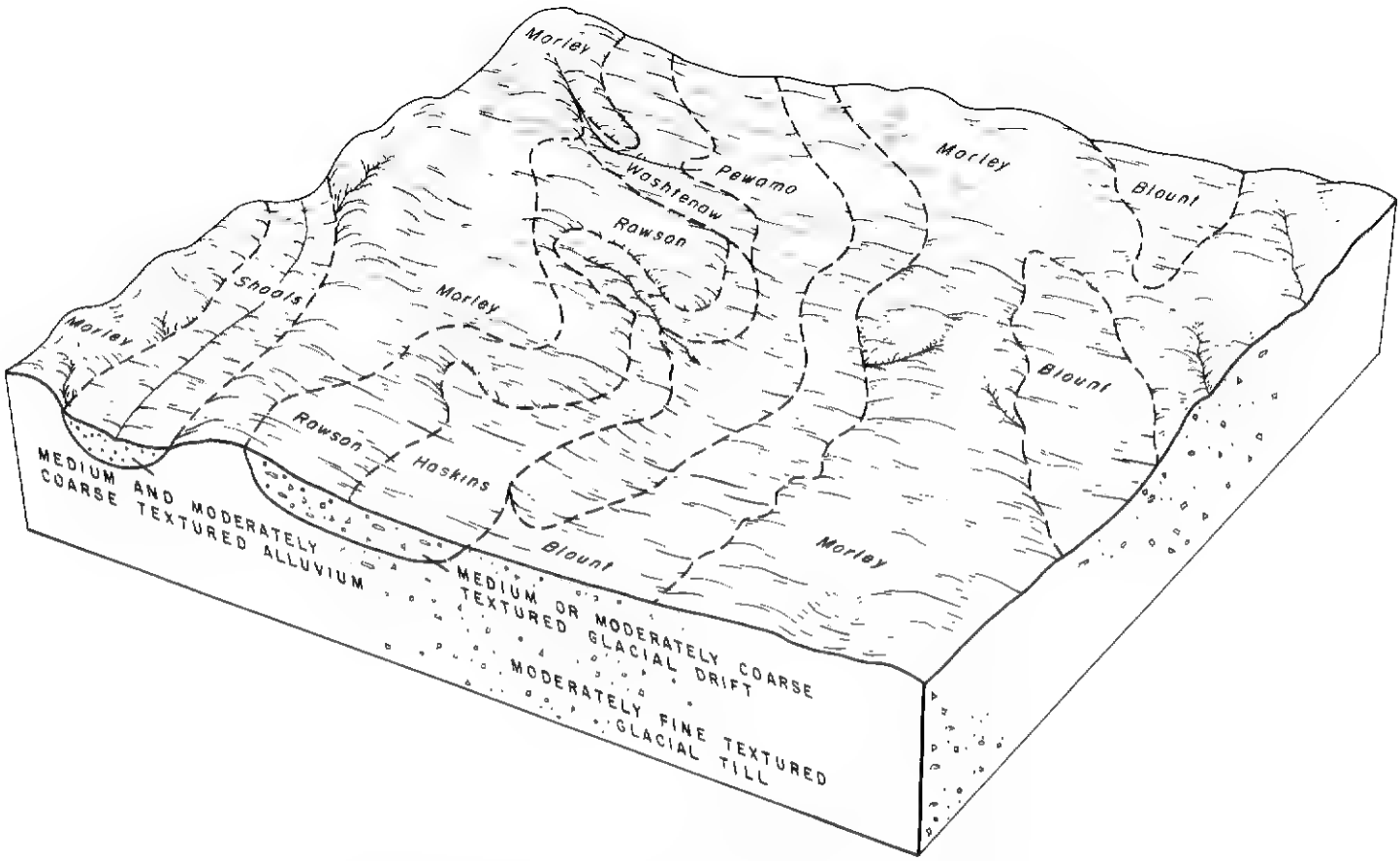

***Figure 4.*—Typical pattern of soils in the Morley-Blount association.**

inches thick. In sequence from the top, it is 3 inches of firm, yellowish brown heavy clay loam; 18 inches of very firm, brown clay mottled with yellowish brown; and 9 inches of firm, brown clay loam mottled with yellowish brown. The substratum to a depth of about 60 inches is brown clay loam mottled with yellowish brown and light brownish gray.

Blount soils are somewhat poorly drained. They are nearly level on flats and in drainageways and are gently sloping on low rises. The surface layer is 7 inches of dark grayish brown silt loam. The subsurface layer is about 2 inches of grayish brown silt loam. The subsoil is about 21 inches thick. In sequence from the top, it is 6 inches of firm, yellowish brown heavy clay loam mottled with grayish brown; 10 inches of very firm, light olive brown silty clay mottled with grayish brown and yellowish brown; and 5 inches of firm, light olive brown clay loam mottled with grayish brown and yellowish brown. The substratum to a depth of about 60 inches is light olive brown clay loam mottled with light olive gray.

Less extensive in this association are Pewamo, Washtenaw, Rawson, Milford, Haskins, and Shoals soils. The very poorly drained Pewamo and Washtenaw soils and poorly drained Milford soils are in depressions and drainageways in the upland. The well drained or moderately well drained Rawson soils are nearly level on flats or gently sloping and moderately sloping on knolls. The somewhat poorly drained Haskins soils are on flats or in drainageways. The somewhat poorly drained Shoals soils are on bottom land along streams.

This association is used mostly for crops. Corn, soybeans, and wheat and grasses and legumes for hay and pasture are the main crops. The available water capacity is high. The surface layer is moderate or low in content of organic matter. Maintaining tilth and organic matter are management needs.

Erosion is a hazard on Morley soils. Wetness is a limitation on Blount soils, and erosion is a hazard in sloping areas. The limitation for septic tank absorption fields is severe.

5. *Morley-Miami association*

Well drained or moderately well drained, moderately sloping to moderately steep, deep soils that have a moderately fine textured or fine textured subsoil; on uplands

This association is moderately sloping to moderately steep on knolls and breaks along drainageways. It makes up about 6 percent of the county. It is about 55 percent Morley soils, 15 percent Miami soils, and 30 percent soils of minor extent (fig. 5).

Morley soils are moderately well drained or well drained. They are on knolls and along drainageways. The surface layer and subsurface layer are 9 inches of dark grayish brown silt loam. The subsoil is about 30

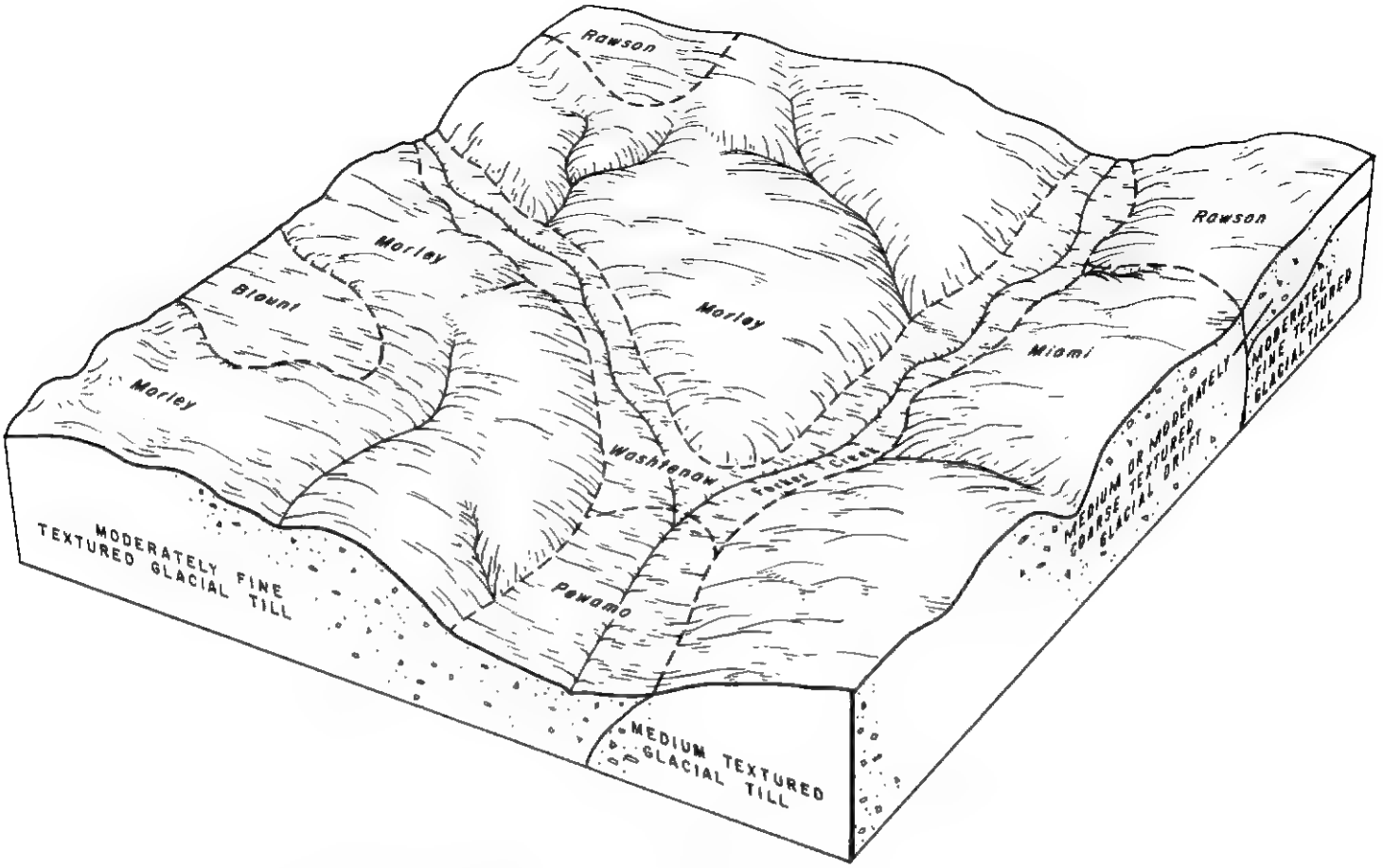

Figure 5.—Typical pattern of soils in the Morley-Miami association.

inches thick. In sequence from the top, it is 3 inches of firm, yellowish brown heavy clay loam; 18 inches of very firm, brown clay mottled with yellowish brown; and 9 inches of firm, brown clay loam mottled with yellowish brown. The substratum to a depth of about 60 inches is brown clay loam mottled with yellowish brown and light brownish gray.

Miami soils are well drained. They are on knolls, breaks, and ridges in the upland. The surface layer is 8 inches of dark grayish brown loam. The subsurface layer is 3 inches of dark grayish brown loam. The subsoil is about 27 inches thick. In sequence from the top, it is 3 inches of friable, brown light clay loam; 12 inches of firm, dark yellowish brown clay loam; 9 inches of firm, yellowish brown clay loam; and 3 inches of friable, brown light clay loam. The substratum to a depth of about 60 inches is pale brown loam.

Less extensive in this association are Washtenaw, Pewamo, Shoals, Rawson, and Blount soils. The very poorly drained Washtenaw and Pewamo soils occupy depressions and drainageways. The somewhat poorly drained Blount soils are on flats, on low rises, and drainageways. The somewhat poorly drained Shoals soils are on bottom land along streams. The well drained and moderately well drained Rawson soils are on knolls and side slopes in the upland.

This association is used mostly for hay, pasture, and woodland. Some moderately sloping areas and a few strongly sloping areas are used for crops. Grasses and legumes for hay and pasture, corn, and wheat are the main crops. The available water capacity is high. The surface layer is moderate or low in content of organic matter. Maintaining tilth and organic matter are management needs.

Erosion is a serious hazard. The limitation for septic tank absorption fields is severe.

Moderately Deep or Deep, Somewhat Poorly Drained to Very Poorly Drained, Nearly Level Mineral and Organic Soils That Have a Moderately Fine Textured or Fine Textured Subsoil or Organic Material; on Uplands or Outwash Plains

The associations in this group are dominated by soils that are somewhat poorly drained to very poorly drained and are nearly level. They make up about 15 percent of the county. They are used chiefly for corn and soybeans where drainage systems have been installed. Some wheat and grasses and legumes for forage are also grown. Undrained areas are used mainly for pasture, woodland, or wetland wildlife habitat.

6. Haskins-Toledo association

Somewhat poorly drained and very poorly drained, nearly level, deep soils that have a moderately fine tex-

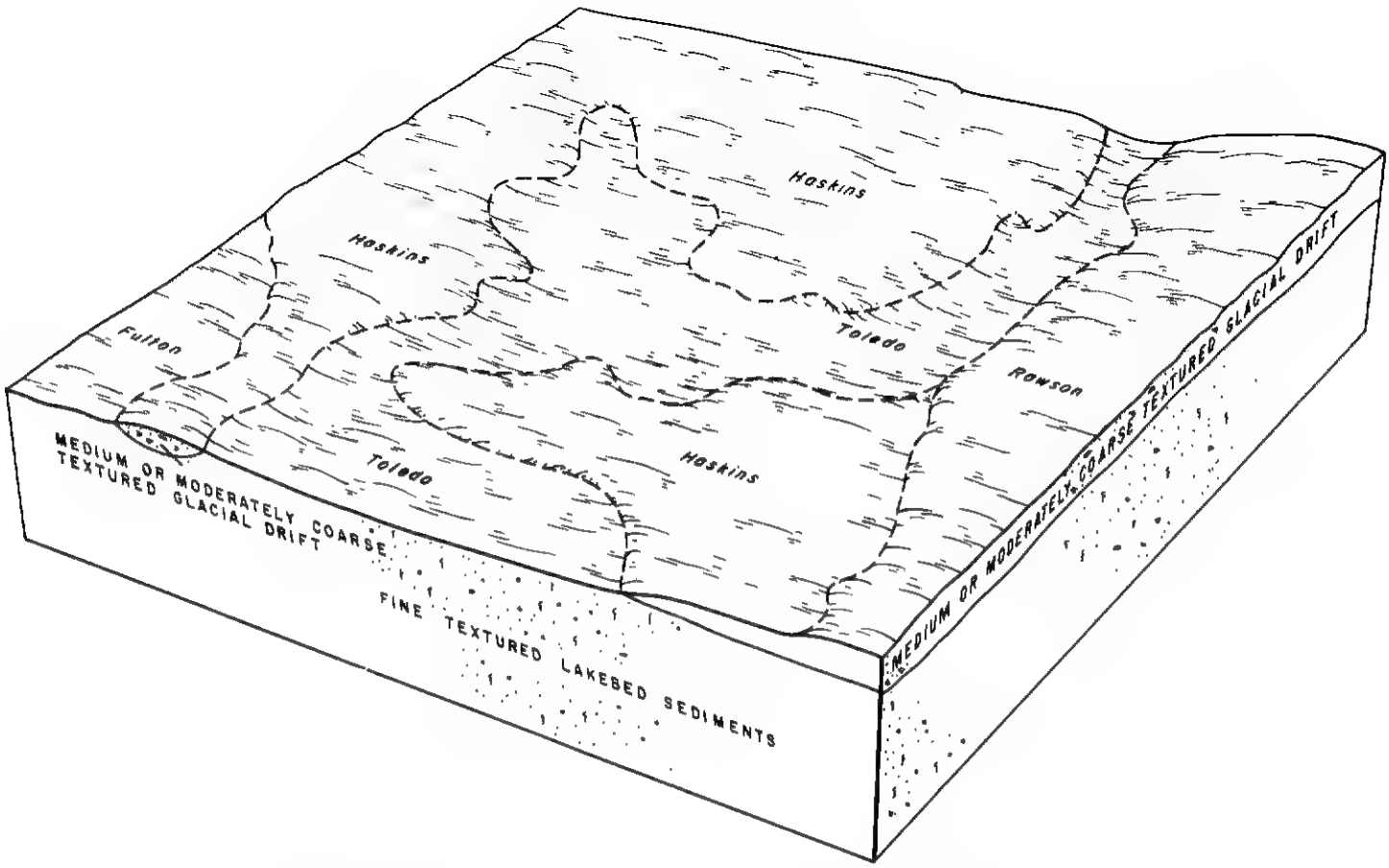

***Figure 6.*—Typical pattern of soils in the Haskins-Toledo association.**

tured or fine textured subsoil; on outwash plains and uplands

This association is nearly level on flats and in depressions or drainageways. It makes up about 2 percent of the county. It is about 50 percent Haskins soils, 25 percent Toledo soils, and 25 percent soils of minor extent (fig. 6).

Haskins soils are somewhat poorly drained. They are on flats and in drainageways in the upland and on outwash plains. The surface layer is 8 inches of dark grayish brown loam. The subsurface layer is 3 inches of grayish brown loam mottled with yellowish brown. The subsoil is about 30 inches thick. In sequence from the top, it is 13 inches of firm, grayish brown light clay loam mottled with yellowish brown; 13 inches of very firm, brown light silty clay loam mottled with yellowish brown; and 4 inches of very firm, light brownish gray silty clay mottled with yellowish brown. The substratum to a depth of about 60 inches is grayish brown silty clay mottled with yellowish brown.

Toledo soils are nearly level and very poorly drained. They are in depressional areas in the upland and on outwash plains. The surface layer is 8 inches of very dark gray silty clay loam. The subsoil is about 29 inches thick. In sequence from the top, it is 7 inches of very friable, dark gray silty clay mottled with olive brown; 19 inches of very firm, gray silty clay mottled with olive brown and strong brown; 5 inches of very firm, dark gray silty clay mottled with olive brown and yellowish brown; and 5 inches of very firm, gray silty clay mottled with olive brown and yellowish brown. The substratum to a depth of about 60 inches is gray silty clay mottled with olive brown and yellowish brown.

Less extensive in this association are Fulton, Rawson, and Milford soils. The somewhat poorly drained Fulton soils are on flats in the upland and on outwash plains. The well drained or moderately well drained Rawson soils occupy knolls in the upland and outwash plains. The poorly drained Milford soils are in depressions and drainageways in the uplands and outwash plains.

This association is used mostly for crops. Corn, soybeans, and wheat and grasses and legumes for hay and pasture are the main crops. The available water capacity is high. The surface layer is moderate or high in content of organic matter. Maintaining tilth and organic matter are management needs.

Wetness is a limitation. The limitation for septic tank absorption fields is severe.

7. *Houghton-Edwards-Adrian association*

Very poorly drained, nearly level mucks that are deep or moderately deep over marl or sand and gravel; in depressions on uplands or outwash plains

This association is in depressional areas where partly decomposed plant remains have accumulated over a

long period. Undrained depressions contain water most of the time. The association makes up about 10 percent of the county. It is about 60 percent Houghton soils, 12 percent Edwards soils, 7 percent Adrian soils, and 21 percent soils of minor extent (fig. 7).

Houghton soils are deep. They formed in deposits of organic material in depressions. The surface layer is 10 inches of very friable, black muck. The next layer is 8 inches of very friable, black muck and a few very dark brown herbaceous fibers. Below this to a depth of about 60 inches is very friable, black muck having a few brown and pale brown herbaceous fibers.

Edwards soils are deep and moderately deep. They formed in deposits of organic material over marl in depressions. The surface layer is 22 inches of very friable, black muck. The next layer is 7 inches of very friable, black muck and many yellowish brown and dark reddish brown herbaceous fibers. The substratum to a depth of about 60 inches is light gray marl and many shell fragments.

Adrian soils are deep or moderately deep. They formed in deposits of organic material over loose sand and gravel in depressions. The surface layer is 12 inches of black muck. The next layer is 22 inches of very friable, black muck and common, dark brown herbaceous fibers. The substratum to a depth of about 60 inches is dark gray sand and gravelly sand.

Less extensive in this association are Palms, Wallkill, Gilford, and Sebewa soils. Also included are lakes, several areas of Marsh, and Marl beds that are in depressional areas in the upland or on outwash plains. The very poorly drained Palms and Wallkill soils are in depressional areas in the upland and on outwash plains. The very poorly drained Gilford and Sebewa soils occupy depressional areas and drainageways in outwash plains.

Drained areas of this association are used mostly for crops. Corn and soybeans are the main crops. Such special crops as mint, sweet corn, potatoes, and onions are well suited if the soils are drained. Most undrained areas are idle and have a plant cover of water-tolerant trees, shrubs, sedges, and grasses. The available water capacity is moderate to very high. The content of organic matter is very high.

Soil blowing is a hazard. Wetness is a severe limitation, and drainage is necessary if crops are grown. The limitation for septic tank absorption fields is severe. Houghton soils are a potential source of peat moss, and Edwards soils are a source of marl.

8. Homer-Sebewa association

Somewhat poorly drained and very poorly drained, nearly level soils that have a moderately fine textured subsoil and are moderately deep over sand and gravel; on outwash plains

This association is on broad outwash plains where the seasonal high water table is at or near the surface or is ponded. It makes up about 3 percent of the county. It is about 40 percent Homer soils, 30 percent Sebewa soils, and 30 percent soils of minor extent (fig. 8).

Homer soils are somewhat poorly drained and are moderately deep to loose sand and gravelly sand. They are on flats between depressions on outwash plains. The surface layer is about 8 inches of dark brown loam. The

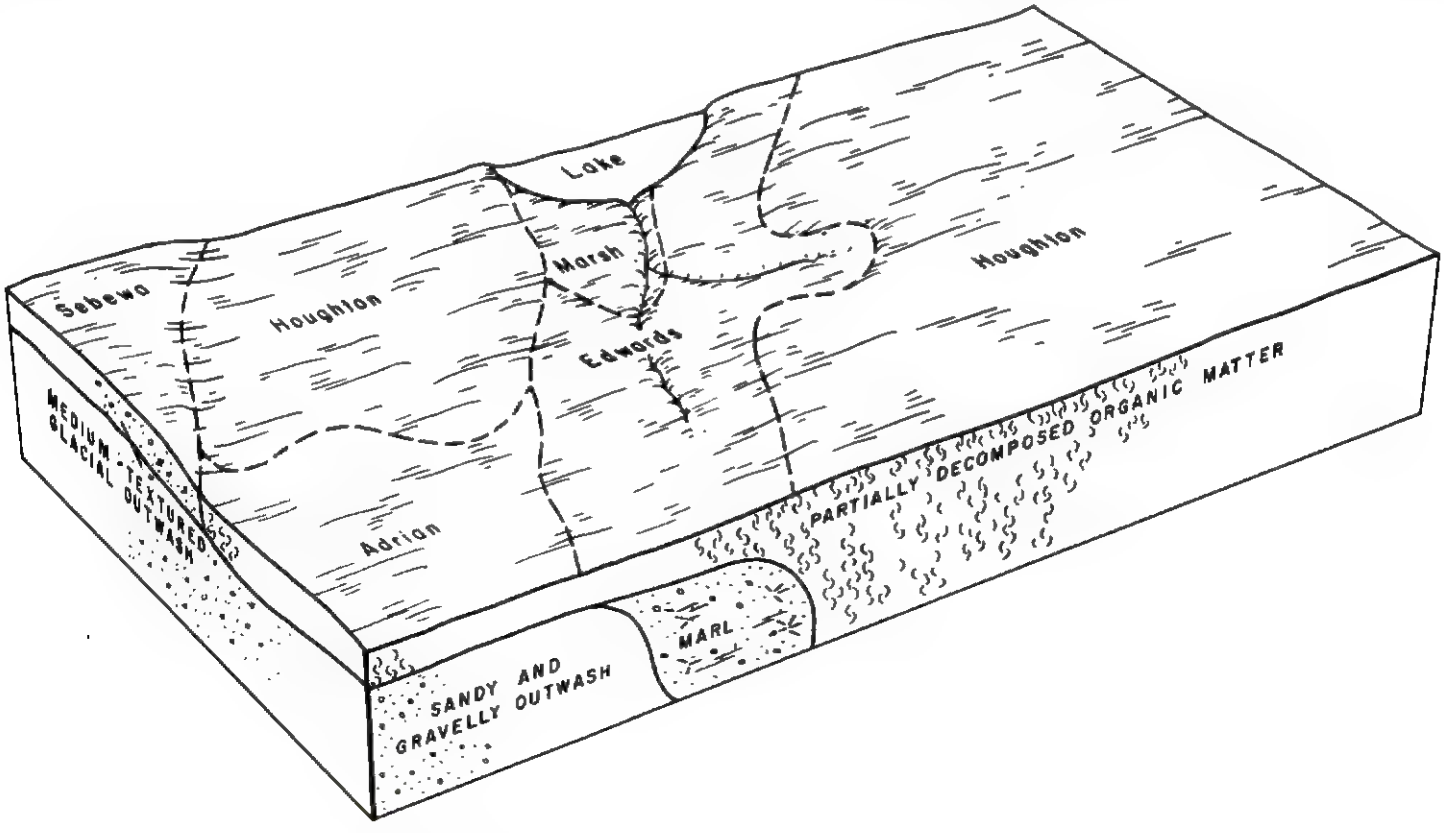

Figure 7.—Typical pattern of soils in the Houghton-Edwards-Adrian association.

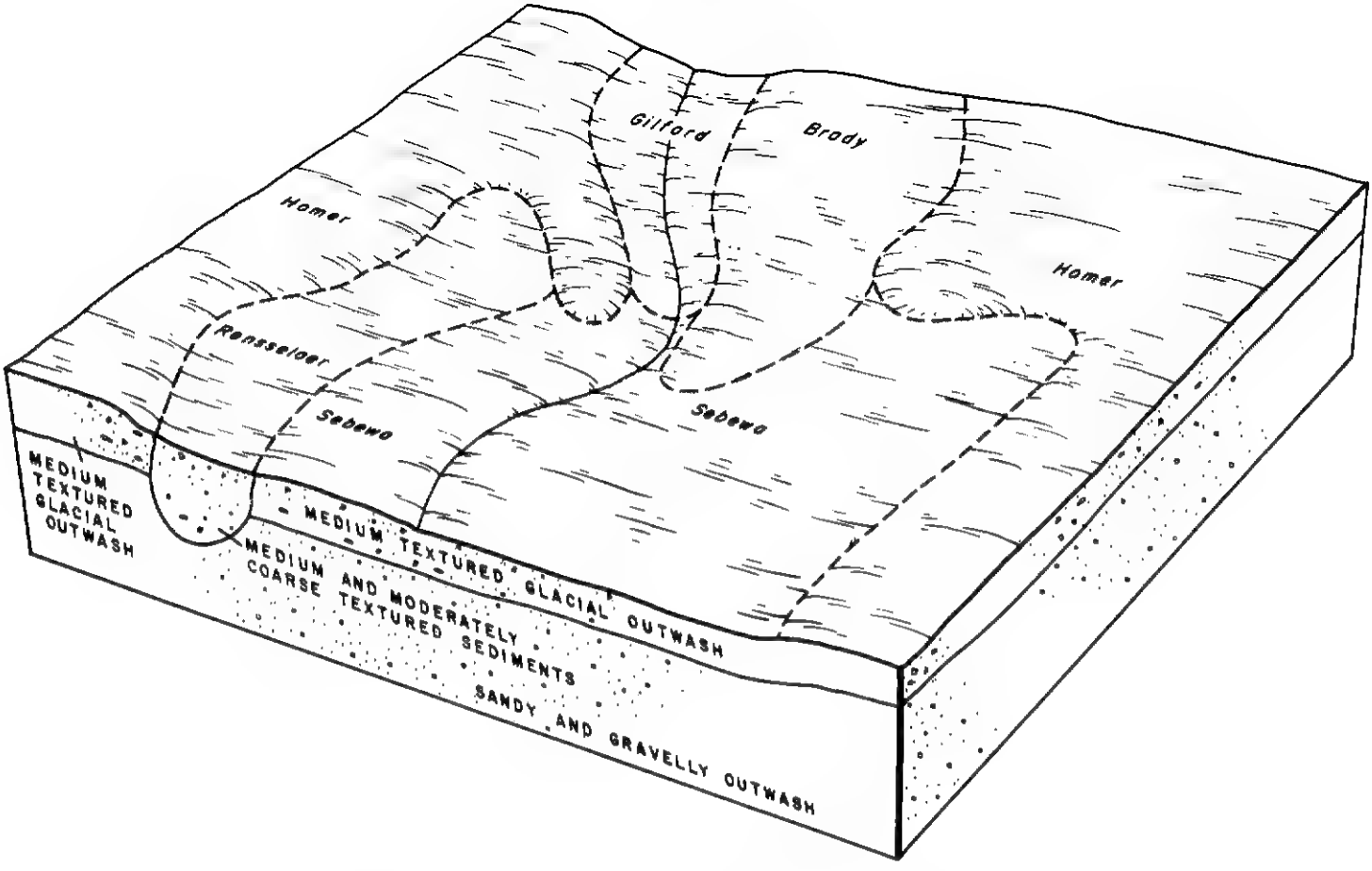

Figure 8.—Typical pattern of soils in the Homer-Sebewa association.

subsurface layer is about 2 inches of dark grayish brown loam. The subsoil is about 28 inches thick. In sequence from the top, it is 8 inches of firm, yellowish brown heavy loam mottled with grayish brown and dark grayish brown; 7 inches of firm, light brownish gray sandy clay loam mottled with gray and yellowish brown; 9 inches of firm, brown gravelly sandy clay loam mottled with gray and dark brown; and 4 inches of very friable, dark grayish brown gravelly sandy loam and loamy sand. The substratum to a depth of about 60 inches is brown, stratified sand and gravelly sand.

Sebewa soils are very poorly drained and are moderately deep to loose sand and gravelly sand. They are in depressions and drainageways on outwash plains. The surface layer is about 12 inches of very dark gray loam. The subsoil is 26 inches thick. In sequence from the top, it is 12 inches of firm, gray sandy clay loam mottled with light olive brown and brown; 10 inches of firm, grayish brown sandy clay loam mottled with light olive brown; and 4 inches of friable, gray gravelly sandy clay loam mottled with light olive brown. The substratum to a depth of 60 inches is light brownish gray sand and gravelly sand.

Less extensive in this association are Rensselaer, Gilford, and Brady soils. The very poorly drained Rensselaer and Gilford soils are in depressions and drainageways in outwash plains. The somewhat poorly drained Brady soils are on flats between depressions in outwash plains.

This association is used mostly for crops. Corn, soybeans, and wheat are the main crops. The available water capacity is moderate. The surface layer is moderate or high in content of organic matter. Maintaining organic matter is a management need.

Wetness is a limitation. The limitation for septic tank absorption fields is severe. These soils are a source of sand and gravel.

Descriptions of the Soils

This section describes the soil series and mapping units in Noble County. Each soil series is described in detail and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this

profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The symbol following color names in the representative profile descriptions refers to a standard color notation. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Lake borders and Marshes, for example, do not belong to a soil series, but nevertheless, are listed in alphabetical order along with the soil series.

Preceding the name of each mapping unit is a symbol. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland group to which the mapping unit has been assigned. The page for the description of each capability unit can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The approximate acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing the soils can be found in the Glossary at the end of this survey. More detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*11*).[1]

Descriptions, names, and delineations of soils in this soil survey do not fully agree with soil maps for adjacent counties published at a different date. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, and the extent of soils within the survey. Sometimes it is more feasible to combine small acreages of similar soils that respond to use and management in much the same way than it is to manage them separately.

[1] Italic numbers in parentheses refer to Literature Cited, p. 115.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent	Soil	Acres	Percent
Adrian muck	1,250	0.5	Miami loam, gravelly substratum, 0 to 2 percent slopes	2,800	1.1
Adrian muck, drained	830	.3	Miami loam, gravelly substratum, 2 to 6 percent slopes, eroded	2,700	1.0
Aubbeenaubbee fine sandy loam	750	.3	Milford silty clay loam	4,400	1.7
Blount silt loam, 0 to 2 percent slopes	8,500	3.2	Morley silt loam, 2 to 6 percent slopes, eroded	23,000	8.8
Blount silt loam, 2 to 4 percent slopes, eroded	2,050	.8	Morley silt loam, 6 to 12 percent slopes, eroded	4,650	1.8
Boyer loamy sand, 2 to 6 percent slopes	1,150	.4	Morley silt loam, 12 to 18 percent slopes, eroded	750	.3
Boyer loamy sand, 6 to 12 percent slopes	1,250	.5	Morley silty clay loam, 6 to 12 percent slopes, severely eroded	12,400	4.7
Boyer loamy sand, 12 to 18 percent slopes, eroded	1,050	.4	Morley silty clay loam, 12 to 18 percent slopes, severely eroded	2,600	1.0
Brady sandy loam	970	.4	Morley soils, 18 to 25 percent slopes	1,700	.6
Brookston silt loam	9,400	3.6	Morley, Miami, and Rawson loams, 6 to 12 percent slopes, eroded	1,000	.4
Casco sandy clay loam, 8 to 15 percent slopes, severely eroded	1,650	.6	Oshtemo loamy sand, 2 to 6 percent slopes	3,500	1.3
Chelsea fine sand, 2 to 6 percent slopes	1,050	.4	Oshtemo loamy sand, 6 to 12 percent slopes	1,700	.6
Chelsea fine sand, 6 to 12 percent slopes	600	.2	Oshtemo sandy loam, 0 to 2 percent slopes	2,500	1.0
Crosier loam, 0 to 2 percent slopes	6,500	2.5	Palms muck, drained	1,300	.5
Edwards muck	1,400	.5	Parr loam, 0 to 2 percent slopes	860	.3
Edwards muck, drained	2,200	.8	Pewamo silty clay loam	12,000	4.6
Fox sandy loam, 0 to 2 percent slopes	9,290	3.5	Rawson sandy loam, 2 to 6 percent slopes	3,500	1.3
Fox sandy loam, 2 to 6 percent slopes	11,500	4.4	Rawson sandy loam, 6 to 12 percent slopes, eroded	1,150	.4
Fox sandy loam, 6 to 12 percent slopes, eroded	4,900	1.9	Rawson loam, 0 to 2 percent slopes	1,000	.4
Fox-Casco sandy loams, 12 to 18 percent slopes, eroded	970	.4	Rawson loam, 2 to 6 percent slopes	7,600	2.9
Fox-Casco sandy loams, 18 to 25 percent slopes, eroded	354	.1	Rawson, Morley, and Miami loams, 2 to 6 percent slopes, eroded	4,800	1.8
Fulton silt loam	244	(1)	Rensselaer loam	3,400	1.3
Gilford sandy loam	1,350	.5	Riddles sandy loam, 0 to 2 percent slopes	1,200	.5
Haskins loam, 0 to 2 percent slopes	4,200	1.6	Riddles sandy loam, 2 to 6 percent slopes	13,000	5.0
Homer loam	2,450	.9	Riddles sandy loam, 6 to 12 percent slopes, eroded	4,900	1.9
Houghton muck	6,300	2.4	Riddles sandy loam, 12 to 18 percent slopes, eroded	820	.3
Houghton muck, drained	9,100	3.5	Sebewa loam	7,850	3.0
Lake borders	610	.2	Shoals silt loam	1,200	.5
Marl beds	660	.2	Toledo silty clay loam	2,000	.8
Marsh	2,100	.8	Wallkill silt loam	1,050	.4
Martinsville fine sandy loam, 2 to 6 percent slopes	540	.2	Warsaw loam, 0 to 2 percent slopes	1,550	.6
Metea loamy fine sand, 2 to 6 percent slopes	1,650	.6	Washtenaw silt loam	4,100	1.6
Miami loam, 2 to 6 percent slopes, eroded	15,300	5.8	Whitaker loam	670	.3
Miami loam, 6 to 12 percent slopes, eroded	3,100	1.2	Water	4,400	1.7
Miami loam, 12 to 18 percent slopes, eroded	255	.1	Gravel pits, Made land, Borrow pits	710	.2
Miami loam, 18 to 25 percent slopes, eroded	417	.2	Total	262,400	100.0
Miami clay loam, 6 to 12 percent slopes, severely eroded	3,050	1.2			
Miami clay loam, 12 to 18 percent slopes, severely eroded	790	.3			

[1] Less than 0.1 percent.

Adrian Series

The Adrian series consists of very poorly drained organic soils. They are moderately deep or deep over sand and gravelly sand. These nearly level soils are in irregularly shaped, depressional areas in the upland and on outwash plains. The depressions were formerly ponded areas in which plant remains accumulated over a long period. The soils formed in partly decomposed organic materials over sandy and gravelly outwash. The native vegetation was sedges, cattails, and water-tolerant trees, shrubs, and grasses.

In a representative profile the surface layer is 12 inches of black muck. The next layer is 22 inches of very friable, black muck and a few dark brown herbaceous fibers. The substratum to a depth of about 60 inches is dark gray sand and gravelly sand.

Permeability is rapid, and the available water capacity is high or very high. The content of organic matter is very high. Runoff is very slow. Some areas are ponded. These soils are subject to subsidence when drained. Wetness is the main limitation. The seasonal high water table is at or near the surface. Soil blowing is a hazard. Trafficability and load-supporting capacity are poor.

Drained areas of these soils are suited to corn, soybeans, sweet corn, mint, onions, potatoes, and many grasses. Undrained areas are suitable for wetland wildlife habitat.

Representative profile of Adrian muck in an undrained area 1,700 feet south and 100 feet west of the northeast corner of sec. 21, T. 35 N., R. 9 E.

Oa1—0 to 12 inches; black (10YR 2/1) rubbed sapric material; less than 10 percent fiber, less than 5 percent rubbed; moderate fine granular structure; very friable; many roots; 10 percent mineral content; slightly acid; clear wavy boundary.

Oa2—12 to 34 inches; black (10YR 2/1) rubbed sapric material; 10 percent fiber, less than 5 percent rubbed; moderate medium granular structure; very friable; many roots; 10 percent mineral content; few dark brown (10YR 3/3) herbaceous fibers; neutral; abrupt wavy boundary.

IIC—34 to 60 inches; dark gray (10YR 4/1) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The organic horizons range from 16 to 44 inches in thickness and from medium acid to neutral in reaction. The Oa1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). In some pedons a few woody fragments of partly decomposed logs and branches are in the Oa2 horizon and thin strata of sand are in the lower part of the horizon. The IIC horizon is loamy sand, sand, or gravelly sand.

Adrian soils are similar to and associated with Palms, Edwards, and Houghton soils. They are underlain by sandy material. Palms soils, in contrast, are underlain by loamy material and Edwards soils by marl. Adrian soils have a thinner Oa horizon than Houghton soils.

Ad—Adrian muck. This soil is in broad, undrained depressional areas where the water table is at or near the surface most of the year. Slopes are 0 to 2 percent. Most areas are 5 to 150 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are some areas of Palms muck. Areas where there are iron-oxide nodules and dark red or yellowish red muck are identified by spot symbols on the soil map. In some areas around lakes in the north-central part of the county, the organic material is only 12 to 16 inches thick.

Wetness is a serious limitation on this Adrian soil, and drainage is needed. Drainage outlets cannot be obtained in many areas because the level of the water table is the same as the water level in the adjacent lakes and streams. Fire is a hazard because muck readily burns when dry.

This soil is not suited to crops. Although some areas have been cultivated, subsidence of the muck has left them too wet for most crops. Areas are used for wetland wildlife habitat and provide some cover and food for other wildlife. Some areas are used for pasture in dry periods. Limitations are severe for most nonfarm uses. Capability unit Vw–3; woodland group 4w23.

Am—Adrian muck, drained. This soil is in drained depressional areas where the water table is at least 2 feet below the surface most of the time. Slopes are 0 to 2 percent. Most areas are 5 to 80 acres in size. The profile of this soil is similar to the one described as representative of the series, but the organic material is more highly oxidized and contains less fiber.

Included with this soil in mapping are small areas of Palms muck, drained. In places the organic material is only 12 to 16 inches thick. Areas where there are many iron-oxide nodules, or bog iron, and dark red or yellowish red muck and areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Adrian soil. Drainage has caused subsidence of the muck, and soil blowing is a hazard when the soil is dry. Fire is a hazard because muck readily burns when dry.

Most areas are used for corn and soybeans. Limitations are severe for most nonfarm uses. Capability unit IVw–3; woodland group 4w23.

Aubbeenaubbee Series

The Aubbeenaubbee series consists of deep, somewhat poorly drained, moderately coarse textured soils. These soils formed in moderately coarse textured glacial drift and the underlying medium textured glacial till on flats and drainageways in the upland. They are nearly level. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 8 inches of dark grayish brown fine sandy loam. The subsurface layer is 3 inches of grayish brown fine sandy loam mottled with light olive brown. The subsoil is about 30 inches thick. The upper 11 inches is very friable, grayish brown fine sandy loam mottled with brown and yellowish brown, and the lower 19 inches is firm, yellowish brown sandy clay loam mottled with grayish brown. The substratum to a depth of about 60 inches is brown loam mottled with light brownish gray.

Permeability is rapid in the upper part of these soils and moderate in the lower part. The available water capacity is high. The content of organic matter is moderate. Runoff is slow. Wetness is a limitation. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for

hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Aubbeenaubbee fine sandy loam in a cultivated field, 1,200 feet south and 250 feet east of the center of sec. 3, T. 35 N., R. 9 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak very fine and fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A2—8 to 11 inches; grayish brown (10YR 5/2) fine sandy loam; few fine distinct light olive brown (2.5YR 5/4) mottles; weak fine granular structure; very friable; slightly acid; clear wavy boundary.

B1g—11 to 22 inches; grayish brown (2.5Y 5/2) fine sandy loam; common fine distinct brown (10YR 5/3) and yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very friable; medium acid; clear wavy boundary.

IIB2t—22 to 34 inches; yellowish brown (10YR 5/6) sandy clay loam; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; thick dark grayish brown (10YR 4/2) clay films on faces of peds; few fine pebbles; grayish brown (2.5Y 5/2) fine sandy loam films in vertical cracks and voids; medium acid; gradual wavy boundary.

IIB22tg—34 to 41 inches; yellowish brown (10YR 5/6) sandy clay loam; many medium distinct grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; firm; common iron- and manganese-oxide concretions; few fine pebbles; dark grayish brown (10YR 4/2) clay films on many vertical cracks and on some faces of peds; slightly acid grading to neutral in lower part; clear wavy boundary.

IIC—41 to 60 inches; brown (10YR 5/3) loam; many medium distinct light brownish gray (10YR 6/2) mottles; massive; friable; few fine pebbles; few thin dark grayish brown (10YR 4/2) clay films on vertical cracks and voids; strong effervescence; moderately alkaline.

The solum ranges from 36 to 50 inches in thickness, and the fine sandy loam upper part ranges from 20 to 36 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A2 horizon is light brownish gray (10YR 6/2) in some pedons. The IIB2 horizon is clay loam or sandy clay loam. The IIC horizon is loam or light clay loam.

Aubbeenaubbee soils are associated with Crosier and Haskins soils. They are coarser textured in the surface layer and the upper part of the subsoil than Crosier soils and are coarser textured throughout than Haskins soils.

Au—Aubbeenaubbee fine sandy loam. This soil occupies irregularly shaped flats and drainageways in the upland. Slopes are 0 to 2 percent. Most areas are 2 to 20 acres in size.

Included with this soil in mapping are low rises where slopes are 2 to 4 percent. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. In a few areas the fine sandy loam upper horizons are 10 to 18 inches thick Also included are a few small mounds of well drained Metea loamy fine sand.

Wetness is a limitation on this Aubbeenaubbee soil, and drainage is needed. Maintaining the supply of organic matter is a management need.

Most areas of this soil are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. A few areas are used for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIw–11; woodland group 3o5.

Blount Series

The Blount series consists of deep, somewhat poorly drained, medium textured soils. These soils are nearly level on flats and gently sloping on low rises and along drainageways in the upland. They formed in moderately fine textured glacial till. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 7 inches of dark grayish brown silt loam. The subsurface layer is 2 inches of grayish brown silt loam. The subsoil is 21 inches thick. In sequence from the top, it is 6 inches of firm, yellowish brown heavy clay loam mottled with grayish brown and light yellowish brown; 10 inches of very firm, light olive brown silty clay mottled with grayish brown and yellowish brown; and 5 inches of firm, light olive brown clay loam mottled with grayish brown and yellowish brown. The substratum to a depth of about 60 inches is light olive brown clay loam mottled with light olive gray.

Permeability is slow, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow or medium. Wetness is a limitation. Erosion is a hazard on sloping soils. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Blount silt loam, 0 to 2 percent slopes, in a cultivated field, 25 feet east and 1,025 feet south of the center of sec. 14, T. 33 N., R. 11 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; friable; neutral; abrupt smooth boundary.

A2—7 to 9 inches; grayish brown (10YR 5/2) silt loam; weak medium platy structure parting to moderate medium granular; friable; neutral; clear smooth boundary.

B21t—9 to 15 inches; yellowish brown (10YR 5/4 and 5/6) heavy clay loam; many medium distinct grayish brown (10YR 5/2) mottles and many fine faint light yellowish brown (10YR 6/4) mottles; moderate fine and medium subangular blocky structure; firm; thin discontinuous grayish brown (10YR 5/2) silt and very fine sand coatings on faces of peds; firm; few fine pebbles; brown (10YR 4/3) and dark grayish brown (10YR 4/2) clay films on most faces of peds; slightly acid; clear smooth boundary.

B22t—15 to 20 inches; light olive brown (2.5Y 5/4) silty clay; common fine distinct grayish brown (2.5Y 5/2) mottles and few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very firm; few fine pebbles; dark grayish brown (10YR 4/2) clay films on most faces of peds; medium acid; clear wavy boundary.

B23t—20 to 25 inches; light olive brown (2.5Y 5/4) silty clay; many fine distinct grayish brown (2.5Y 5/2) mottles and few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine angular blocky structure; very firm; few fine pebbles; continuous dark grayish brown (10YR 4/2) clay films on most faces of peds; slightly acid; clear wavy boundary.

B3t—25 to 30 inches; light olive brown (2.5Y 5/4) clay loam; many fine distinct grayish brown (2.5Y 5/2) mottles and few fine prominent yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; dark grayish brown (10YR 4/2) clay films on vertical ped faces and voids; neutral; gradual wavy boundary.

C—30 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many fine distinct light olive gray (5Y 6/2) mottles;

massive; firm; few fine pebbles; few light olive gray (5Y 6/2) fillings in cracks; strong effervescence; moderately alkaline.

The solum ranges from 22 to 36 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A2 horizon is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). The B22t and B23t horizons are silty clay or heavy silty clay loam. The C horizon is silty clay loam or clay loam.

Blount soils are similar to Haskins and Fulton soils. They contain more clay in the upper part of the subsoil than Haskins soils and less clay in the subsoil and underlying material than Fulton soils.

BlA—Blount silt loam, 0 to 2 percent slopes. This soil is on flats between depressions and in shallow drainageways in the upland. Most areas are 3 to 30 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small depressional areas of Pewamo soils. A few low rises have slopes of 2 to 4 percent. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map.

Wetness is a limitation on this Blount soil, and drainage is needed. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 3 feet. Maintaining the supply of organic matter is a management need.

Most areas of this soil are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. A few areas are used for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIw-2; woodland group 3o5.

B1B2—Blount silt loam, 2 to 4 percent slopes, eroded. This soil occupies low rises and slopes along drainageways and depressions in the upland. Areas are mostly undulating. Most are 2 to 5 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thinner and is grayish brown and the upper part of the subsoil has fewer grayish brown mottles. About 3 to 5 inches of the surface layer has been removed by erosion. The present plow layer is a mixture of the surface layer and the yellowish brown subsoil.

Included with this soil in mapping are small areas of Haskins loam and Morley silt loam. Also included are a few, small, uneroded areas where the surface layer is thicker.

Wetness is a limitation on this Blount soil, and drainage is needed. Runoff is medium. Erosion is a hazard. Maintaining the supply of organic matter and preventing erosion are management needs.

This soil is suited to row crops most of the time. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. A few areas are used for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIe-13; woodland group 3o5.

Boyer Series

The Boyer series consists of well drained, coarse textured soils that are moderately deep over stratified sand and gravelly sand. These soils formed in moderately coarse textured glacial outwash. They are on breaks along drainageways and around potholes on outwash plains and on knolls in the upland. They are gently sloping to strongly sloping. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 8 inches of dark brown loamy sand. The subsoil is about 24 inches thick. In sequence from the top, it is 3 inches of very friable, brown loamy sand; 4 inches of very friable, brown sandy loam; 4 inches of friable, dark brown light sandy clay loam; and 13 inches of very friable, dark brown sandy loam. The substratum to a depth of about 60 inches is pale brown sand and gravelly sand.

Permeability is moderately rapid, and the available water capacity is low. The content of organic matter is low. Runoff is slow or medium. Droughtiness is a limitation. Erosion is a hazard on sloping soils. Soil blowing is also a hazard.

Where slopes are 2 to 12 percent, these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Where slopes are more than 12 percent, they are better suited to hay, pasture, or woodland. Because of droughtiness, crops that mature early in the season are best suited.

Representative profile of Boyer loamy sand, 2 to 6 percent slopes, in a cultivated field, 150 feet east and 250 feet south of the northwest corner of sec. 16, T. 34 N., R. 9 E.

Ap—0 to 8 inches; dark brown (10YR 4/3) loamy sand; weak fine granular structure; very friable; 5 percent fine gravel; slightly acid; abrupt smooth boundary.

B1—8 to 11 inches; brown (7.5YR 5/4) loamy sand; weak fine subangular blocky structure; very friable; 10 percent fine gravel; slightly acid; clear wavy boundary.

B21t—11 to 15 inches; brown (7.5YR 4/4) sandy loam; weak medium subangular blocky structure; very friable; discontinuous reddish brown (5YR 4/4) clay films on most faces of peds; 10 percent fine gravel; medium acid; clear wavy boundary.

B22t—15 to 19 inches; dark brown (7.5YR 4/4) light sandy clay loam; weak medium subangular blocky structure; friable; discontinuous dark reddish brown (5YR 3/4) clay films on most faces of peds; 10 percent fine gravel; medium acid; clear wavy boundary.

B23t—19 to 32 inches; dark brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; very friable; discontinuous reddish brown (5YR 4/4) clay films on faces of some peds and bridges between sand grains; 10 percent fine gravel; slightly acid; abrupt irregular boundary.

IIC—32 to 60 inches; pale brown (10YR 6/3) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum is 28 to 40 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 5/3 or 4/3) loamy sand or sandy loam. The B2t horizon is dominantly sandy loam. In some pedons, it contains a layer of light sandy clay loam or light gravelly clay loam less than 6 inches thick. In some pedons, the lower part of the B2 horizon is gravelly loamy sand or loamy sand. Tongues extend from the lower part of the Bt horizon into the IIC horizon. The IIC horizon is typically stratified gravel and sand, but in some pedons it is dominantly coarse sand.

Boyer soils are associated with Oshtemo, Fox, and Casco soils. They have a thicker solum than Casco soils and a thinner solum than Oshtemo soils. They have a coarser textured subsoil than Fox or Casco soils.

BoB—Boyer loamy sand, 2 to 6 percent slopes. This gently sloping soil is on ridgetops and knolls and on breaks along drainageways and around potholes. It occurs on outwash plains and in the upland. Most areas are 5 to 40 acres in size. The profile of this soil is the one described as representative of the series (fig. 9).

Figure 9.—Profile of Boyer loamy sand, 2 to 6 percent slopes.

Included with this soil in mapping are small areas where the surface layer is sandy loam or gravelly sandy loam and small areas of Oshtemo loamy sand. Identified by spot symbols on the soil map are potholes less than 2 acres in size that have eroded side slopes and 2 to 3 feet of dark brown sandy loam in the lower part, and small areas where gravel on the surface interferes with tillage.

Droughtiness is a limitation and erosion and soil blowing are hazards on this Boyer soil. The soil absorbs water readily and is easy to work. Runoff is slow. Maintaining the supply of organic matter is a management need.

This soil is suited to row crops most of the time. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. Irrigated areas are well suited to these crops. A few areas are used for woodland. Limitations are slight for most nonfarm uses. Capability unit IIIs–2; woodland group 3s17.

BoC—Boyer loamy sand, 6 to 12 percent slopes. This soil is on side slopes of ridges and knolls and on breaks along drainageways and around potholes. It occurs on outwash plains and in the upland. Most areas are 3 to 30 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is somewhat lighter in color.

Included with this soil in mapping are some areas where the surface layer is sandy loam or gravelly sandy loam and small areas of Oshtemo loamy sand. Identified by spot symbols on the soil map are potholes less than 2 acres in size that have eroded side slopes and 2 to 3 feet of dark brown sandy loam in the lower part, and areas where pebbles on the surface interfere with tillage. Also included are severely eroded areas where the surface layer is brown sandy loam or gravelly sandy loam.

Droughtiness is a limitation and erosion and soil blowing are hazards on this Boyer soil. The soil absorbs water readily and is easy to work. Runoff is medium. Maintaining the supply of organic matter is a management need. Slope limits irrigation.

This soil is suitable for row crops under good management. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. Limitations are moderate for most nonfarm uses. Capability unit IIIe–13; woodland group 3s17.

BoD2—Boyer loamy sand, 12 to 18 percent slopes, eroded. This soil occupies ridges or knolls and narrow breaks around potholes and along drainageways of the outwash plains. Most areas are 3 to 25 acres in size, but some broad areas on knolls range from 50 to 200 acres. The profile of this soil is similar to the one described as representative of the series, but the surface layer is brown and is a mixture of topsoil and the upper part of the subsoil. Depth to loose sand and gravelly sand is commonly 24 to 30 inches.

Included with this soil in mapping are small areas where the surface layer is sandy loam or gravelly sandy loam and large areas near Diamond Lake Hill and east of Kimmell where slopes are 18 to 30 percent. In a few areas the depth to loose sand and gravelly sand is less than 24 inches. Also included are small areas of Oshtemo loamy sand. Areas where pebbles on the surface interfere with tillage are identified by spot symbols on the soil map.

Droughtiness is a limitation and erosion and soil blowing are hazards on this Boyer soil. Runoff is medium. Maintaining the supply of organic matter is a management need. Slope limits the use of farm machinery.

This soil is well suited to grasses and legumes for hay and pasture and to woodland. Limitations are severe for most nonfarm uses. Capability unit IVe–13; woodland group 3s17.

Brady Series

The Brady series consists of deep, somewhat poorly drained, moderately coarse textured soils. These soils formed in coarse textured glacial outwash on broad outwash plains. They are nearly level. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 9 inches of very dark grayish brown sandy loam. The

subsoil is about 44 inches thick. In sequence from the top, it is 8 inches of friable, pale brown sandy loam mottled with light brownish gray; 14 inches of very friable, pale brown sandy loam that is mottled with light brownish gray and contains bands and soft rounded masses of friable, brown, mottled light sandy clay loam; and 22 inches of very friable, yellowish brown loamy sand that is mottled with grayish brown and contains soft rounded masses of dark brown light sandy loam. The underlying material to a depth of about 60 inches is grayish brown sand and a few fine pebbles.

Permeability is moderately rapid, and the available water capacity is moderate. The content of organic matter is high. Runoff is slow. These soils absorb water readily and are easy to work. Wetness is a limitation. Droughtiness is a limitation during prolonged periods of low rainfall. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Brady sandy loam in a cultivated field, 750 feet south and 500 feet west of the center of sec. 11, T. 35 N., R. 9 E.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; friable; about 6 percent fine gravel; many roots; neutral; abrupt smooth boundary.

A12—7 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium and thick platy structure parting to weak fine and medium granular; friable; about 9 percent fine gravel; many roots and worm holes; neutral; abrupt wavy boundary.

B1—9 to 17 inches; pale brown (10YR 6/3) sandy loam; common fine faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; friable; about 7 percent fine gravel; many small iron and manganese concretions; many worm holes filled with very dark grayish brown (10YR 3/2) heavy sandy loam; slightly acid; clear wavy boundary.

B21t—17 to 31 inches; pale brown (10YR 6/3) sandy loam; many fine faint light brownish gray (10YR 6/2) mottles; weak fine subangular blocky structure; very friable; 5 percent fine gravel; discontinuous brown (10YR 5/3) light sandy clay loam bands, 4 inches thick, and soft rounded masses, ½ inch to 2 inches thick, mottled with common fine distinct gray (10YR 6/1) and brown (7.5YR 4/4); discontinuous gray (10YR 5/1) clay films and bridges between sand grains; many iron- and manganese-oxide concretions; slightly acid; gradual wavy boundary.

B22t—31 to 53 inches; yellowish brown (10YR 5/4) loamy sand; common fine distinct grayish brown (10YR 5/2) mottles; single grained; loose; 5 percent fine gravel; discontinuous bands, 4 inches thick, and soft rounded masses of dark brown (10YR 3/3) light sandy loam, ¼ inch to 1½ inches thick; clay bridges between sand grains and in voids; many iron- and manganese-oxide concretions; slightly acid; gradual irregular boundary.

IIC—53 to 72 inches; grayish brown (2.5Y 5/2) sand; 3 percent fine gravel; single grained; loose; slightly acid.

The solum ranges from 45 to 65 inches in thickness. The Ap horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2) and is 8 to 10 inches thick. Some pedons have an A2 horizon that is light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or brown (10YR 5/3). The B21t and B22t horizons are dominantly loam. Some pedons have bands of light sandy clay loam that, combined, are less than 6 inches thick. The B21t and B22t horizons are slightly acid or medium acid in reaction and are 3 to 10 percent gravel. The IIC horizon is sand or gravelly sand.

Brady soils are associated with Homer and Whitaker soils. They have a coarser textured subsoil and a darker surface layer than Homer soil. They are coarser textured and contain more sand than Whitaker soils.

Br—Brady sandy loam. This soil occupies broad, irregularly shaped flats between drainageways and depressions on glacial outwash plains. Slopes are 0 to 2 percent. Most areas are 20 to 80 acres in size.

Included with this soil in mapping are small areas of a similar soil that is moderately well drained and has a dark gravish brown surface layer. This included soil is on broad flats north of Cosperville near slightly lower lying areas of this Brady soil. In a few areas of Brady soils the surface layer is light loam. Also included are a few small areas where 6 to 10 inches of the subsoil is sandy clay loam or loam and a few small areas of Gilford sandy loam in small drainageways and in potholes.

Wetness is a limitation on this Brady soil. Drainage and maintaining the supply of organic matter are management needs.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, and small grain. Some areas are used for hay or pasture or for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIIw–4; woodland group 3w20.

Brookston Series

The Brookston series consists of deep, very poorly drained, medium textured soils. These soils formed in medium textured glacial till. They occupy flats, drainageways, and shallow depressions in the upland. They are nearly level. The native vegetation was water-tolerant hardwood trees.

In a representative profile the surface layer is 13 inches of very dark silt loam. The subsoil is about 31 inches thick. In sequence from the top, it is 7 inches of firm, dark gray clay loam mottled with olive; 8 inches of firm, gray clay loam mottled with olive and light olive gray; 10 inches of firm, gray clay loam mottled with yellowish brown and olive; and 6 inches of firm, gray clay loam mottled with yellowish brown and olive. The substratum to a depth of about 60 inches is gray loam mottled with olive.

Permeability is moderate, and the available water capacity is high. The content of organic matter is high. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Brookston silt loam in a cultivated field, 200 feet east and 600 feet north of the southwest corner of sec. 16, T. 35 N., R. 9 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark gray (10YR 3/1) silt loam;

weak very fine subangular blocky structure; friable; neutral; clear smooth boundary.

B21tg—13 to 20 inches; dark gray (5Y 4/1) clay loam; common fine prominent olive (5Y 5/4) mottles; moderate fine subangular blocky structure; firm; few fine pebbles; common discontinuous distinct very dark gray (10YR 3/1) clay films; voids filled with very dark gray (10YR 3/1) silt loam; neutral; clear wavy boundary.

B22tg—20 to 28 inches; gray (5Y 5/1) clay loam; common fine distinct olive (5Y 5/6) and light olive gray (5Y 6/2) mottles; moderate medium subangular blocky structure; firm; few fine pebbles; many discontinuous distinct dark gray (10YR 4/1) clay films on peds and linings of voids; few fillings in voids of very dark gray (10YR 3/1) silt loam; neutral; clear wavy boundary.

B23tg—28 to 38 inches; gray (5Y 5/1) clay loam; many fine distinct yellowish brown (10YR 5/6) mottles and common fine distinct olive (5Y 5/4) mottles; moderate medium and coarse subangular blocky structure; firm; few fine pebbles; many discontinuous distinct dark gray (10YR 4/1) clay films on peds and linings of voids; neutral; gradual wavy boundary.

B3tg—38 to 44 inches; gray (5Y 5/1) clay loam; many fine distinct yellowish brown (10YR 5/6) and olive (5Y 5/3) mottles; weak coarse subangular blocky structure; firm; few fine pebbles; few discontinuous distinct dark gray (10YR 4/1) clay films on peds and pebbles; few light gray (10YR 7/1) lime accumulations; mildly alkaline; gradual wavy boundary.

C—44 to 60 inches; gray (5Y 5/1) loam; common fine distinct olive (5Y 5/3) mottles; massive; friable; 5 percent gravel; few light gray (10YR 7/1) lime accumulations; strong effervescence; moderately alkaline.

The solum ranges from 36 to 48 inches in thickness. The A horizon ranges from 11 to 15 inches in thickness and is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The B22tg and B23tg horizons are mainly clay loam or silty clay loam, but some are loam. The C horizon is loam or light clay loam.

Brookston soils are similar to Pewamo and Milford soils. They contain less clay throughout than Pewamo or Milford soils.

Bx—Brookston silt loam. This soil occupies broad flats and shallow, narrow, meandering depressions and drainageways of the upland. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 10 to 100 acres in size.

Included with this soil in mapping are small areas of Crosier loam on low rises and adjacent flats. The surface layer is loam in some areas where associated soils have a sandy loam surface layer. Also included are a few small areas of Milford silty clay loam in some deeper depressional areas. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Brookston soil, and drainage is needed. Erosion is a hazard along narrow drainageways during periods of heavy rainfall.

This soil is suited to row crops year after year. Most drained areas are used for corn, soybeans, and wheat and for grasses and legumes for hay or pasture. Undrained areas are used for woodland or pasture. Limitations are severe for most nonfarm uses. Capability unit IIw–1; woodland group 2w11.

Casco Series

The Casco series consists of well drained to somewhat excessively drained, moderately fine textured soils that are shallow over loose sand and gravelly sand. These moderately sloping to moderately steep soils are on knolls and breaks along drainageways and depressions and around potholes of the outwash plains. They are also on knolls in the upland. They formed in medium textured outwash. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 7 inches of dark yellowish brown sandy clay loam. The subsoil is about 11 inches thick. The upper 8 inches is firm, dark brown clay loam and the lower 3 inches is friable, dark yellowish brown sandy clay loam. The substratum to a depth of about 60 inches is brown sand and gravelly sand.

Permeability is moderate, and the available water capacity is low. The content of organic matter is low. Runoff is rapid or very rapid. Droughtiness is a serious limitation. Erosion is a hazard.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Because of droughtiness, crops that mature early in the season are best suited. Areas where slopes are more than 12 percent are best suited to hay, pasture, or woodland.

Representative profile of Casco sandy clay loam, 6 to 12 percent slopes, severely eroded, in a cultivated field, 850 feet south and 1,700 feet east of northwest corner of sec. 15, T. 35 N., R. 10 E.

Ap—0 to 7 inches; dark yellowish brown (10YR 3/4) sandy clay loam, brown (10YR 5/5) dry; weak very fine subangular blocky structure; friable; 5 percent fine gravel; numerous roots; slightly acid; abrupt smooth boundary.

B21t—7 to 15 inches; dark brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; firm; thick continuous dark brown (10YR 3/3) clay films on faces of peds; about 10 percent fine gravel; few roots; neutral; clear wavy boundary.

B22t—15 to 18 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak fine and very fine subangular blocky structure; friable; thick continuous dark brown (10YR 3/3) clay films on faces of peds; about 5 percent fine gravel; neutral; abrupt irregular boundary.

IIC—18 to 60 inches; brown (10YR 5/3) weakly stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 12 to 24 inches in thickness. The Ap horizon is dark yellowish brown (10YR 4/4) or dark brown (7.5YR 4/4). In uneroded pedons it is sandy loam. The B21t and B22t horizons are sandy clay loam, clay loam, or gravelly sandy clay loam. Content of gravel ranges from 5 to 40 percent in the B21t and B22t horizons. The IIC material is mainly coarse sand in some pedons.

Casco soils are associated with Fox and Boyer soils. They have a thinner solum than those soils and a finer textured subsoil than Boyer soils.

CcC3—Casco sandy clay loam, 8 to 15 percent slopes, severely eroded. This soil occupies long, narrow breaks along drainageways and around potholes of the outwash plains. It also occupies knolls in the uplands. Slopes are generally short. Most areas are 5 to 20 acres in size.

Included with this soil in mapping are small, less eroded areas where the surface layer is sandy loam and small areas where the subsoil is sandy loam. Also included are small areas that are either less sloping or more sloping and many very small areas of Fox sandy loam. Areas ½ acre to 2 acres in size where pebbles on the surface interfere with tillage and potholes where 2 to 3 feet of dark brown loam are in the

lower part are identified by spot symbols on the soil map.

Droughtiness is a serious limitation and erosion is a hazard on this Casco soil. Runoff is rapid or very rapid. Slope limits irrigation and the use of farm machinery.

This soil is suited to hay and pasture. It is not well suited to row crops. Special management is needed when the soil is used occasionally for corn, soybeans, and small grain. Limitations are severe for most nonfarm uses. Capability unit VIe–3; woodland group 3s17.

Chelsea Series

The Chelsea series consists of deep, excessively drained, coarse textured soils. These soils formed in coarse textured outwash. They occupy knolls or breaks along drainageways in the upland. They are gently sloping or moderately sloping. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 9 inches of dark brown fine sand. The subsurface layer is 2 inches of grayish brown fine sand. The subsoil is about 44 inches thick. In sequence from the top, it is 18 inches of loose, dark yellowish brown fine sand; 11 inches of loose, yellowish brown fine sand; and 15 inches of loose, light yellowish brown fine sand that has about 4 inches of yellowish brown loamy fine sand in ½- to 1-inch bands. The substratum to a depth of about 65 inches is light yellowish brown fine sand.

Permeability is rapid, and the available water capacity is low. The content of organic matter is low. Runoff is slow or medium. Droughtiness is a severe limitation. Soil blowing is a hazard.

These soils are best suited to orchards, Christmas trees, and vineyards. Some areas are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture.

Representative profile of Chelsea fine sand, 2 to 6 percent slopes, in an orchard, 700 feet east and 1,240 feet north of the center of sec. 8, T. 35 N., R. 11 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) fine sand, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A2—9 to 11 inches; grayish brown (10YR 5/2) fine sand; weak fine and medium granular structure; very friable; slightly acid; clear smooth boundary.

B21—11 to 29 inches; dark yellowish brown (10YR 4/4) fine sand; single grained; loose; medium acid; gradual wavy boundary.

B22—29 to 40 inches; yellowish brown (10YR 5/4) fine sand; single grained; loose; strongly acid; clear wavy boundary.

A&B—40 to 55 inches; light yellowish brown (10YR 6/4) fine sand; single grained; loose; 4 inches of yellowish brown (10YR 5/4) loamy fine sand in ½- to 1-inch thick bands; very weak medium subangular blocky structure; very friable; few clay bridges between sand grains; strongly acid; gradual wavy boundary.

C—55 to 65 inches; light yellowish brown (10YR 6/4) fine sand; single grained; loose; medium acid.

The Ap horizon is dark brown (10YR 3/3), dark grayish brown (10YR 4/2), or brown (10YR 4/3). The B21, B22, and A&B horizons are strongly acid to medium acid. The B horizon is dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or brown (7.5YR 4/4) light sandy loam or loamy sand that has a few ¼- to 1½-inch lamellae. Depth to the upper lamellae ranges from 30 to 48 inches. In the upper 60 inches the lamellae, combined, are less than 6 inches thick.

Chelsea soils are similar to Metea soils and are associated with Oshtemo soils. They are not medium textured or moderately fine textured in the lower part of the B horizon and in the C horizon, as Metea soils characteristically are. They contain more fine sand than Oshtemo soils and lack the medium textured or moderately coarse textured B horizon typical of those soils.

ChB—Chelsea fine sand, 2 to 6 percent slopes. This soil is on irregularly shaped ridges or knolls in the upland. Most areas are 3 to 20 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are a few areas that do not have lamellae in the upper 60 inches. In a few places the surface layer is loamy fine sand. Also included are small areas on top of knolls and ridges where slopes are 1 to 2 percent.

Droughtiness is a limitation and soil blowing is a hazard on this Chelsea soil. The soil absorbs water readily. Runoff is slow. Maintaining the supply of organic matter is a management need.

This soil is suited to cultivated crops most of the time. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. Some areas are used for orchards or woodland. Limitations are slight for most nonfarm uses. Capability unit IIIs–1; woodland group 3s17.

ChC—Chelsea fine sand, 6 to 12 percent slopes. This soil occupies irregularly shaped knolls and long, narrow breaks along drainageways in the upland. Slopes are generally short. Most areas are 2 to 10 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is somewhat thinner.

Included with this soil in mapping are a few small areas that do not have lamellae in the upper 60 inches. In a few areas the surface layer is loamy fine sand. Also included are a few small areas, mainly on small knolls and narrow breaks along depressions and drainageways, where slopes are 12 to 18 percent.

Droughtiness is a severe limitation and soil blowing is a hazard on this Chelsea soil. This soil absorbs water readily. Runoff is medium. Maintaining the supply of organic matter is a management need.

This soil is suited occasionally to cultivated crops if soil blowing is controlled. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. Some areas are used for orchards or woodland. Limitations are moderate for most nonfarm uses. Capability unit IIIs–12; woodland group 3s17.

Crosier Series

The Crosier series consists of deep, somewhat poorly drained, medium textured soils. These soils formed in medium textured glacial till. They are on flats and in drainageways. They are nearly level. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 10 inches of dark grayish brown loam. The subsoil is 25 inches thick. In sequence from the top, it is 4 inches of friable, brown light clay loam mottled with grayish

brown; 8 inches of firm, yellowish brown clay loam mottled with grayish brown; and 13 inches of firm, pale brown clay loam mottled with grayish brown and yellowish brown. The substratum to a depth of about 60 inches is brown loam.

Permeability is moderately slow, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow. Wetness is a limitation. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Crosier loam, 0 to 2 percent slopes, in a cultivated field, 2,140 feet east and 350 feet north of the southwest corner of sec. 32, T. 35 N., R. 10 E.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam; weak fine and medium granular structure; friable; 2 percent gravel; neutral; abrupt smooth boundary.

B1—10 to 14 inches; brown (10YR 5/3) light clay loam; many fine distinct grayish brown (10YR 5/2) mottles; weak fine and medium subangular blocky structure; friable; many continuous prominent medium grayish brown (10YR 5/2) silt coatings on peds; 2 percent gravel; voids filled with dark grayish brown (10YR 4/2) loam; few iron- and manganese-oxide concretions; slightly acid; clear smooth boundary.

B21t—14 to 22 inches; yellowish brown (10YR 5/4) clay loam; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; many continuous prominent medium dark grayish brown (10YR 4/2) clay films on faces of peds and linings of voids; 3 percent gravel; few iron- and manganese-oxide concretions; medium acid; clear wavy boundary.

B22t—22 to 35 inches; pale brown (10YR 6/3) clay loam; many fine distinct grayish brown (2.5Y 5/2) mottles and common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; many continuous prominent medium dark grayish brown (10YR 4/2) clay films on faces of peds and linings of voids; 3 percent gravel; few iron- and manganese-oxide concretions; slightly acid grading to neutral in lower part; clear wavy boundary.

C—35 to 60 inches; brown (10YR 5/3) loam; common fine distinct yellowish brown (10YR 5/8) mottles and many fine faint grayish brown (10YR 5/2) mottles; massive; friable; 10 percent gravel; strong effervescence; moderately alkaline.

The solum ranges from 28 to 40 inches in thickness. Content of gravel ranges from 2 to 10 percent. The Ap horizon is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2). Some pedons have an A2 horizon of grayish brown (10YR 5/2) or light brownish gray (10YR 6/2) loam. Most pedons that have an A2 horizon do not have a B1 horizon. The B21t and B22t horizons are dominantly clay loam or silty clay loam, but range to heavy loam. The C horizon is heavy sandy loam or loam.

Crosier soils are similar to Blount and Haskins soils. They contain less clay throughout than Blount soils and less clay in the lower part of the subsoil and in the substratum than Haskins soils.

CrA—Crosier loam, 0 to 2 percent slopes. This nearly level soil occupies the irregularly shaped flats between depressions and in drainageways of the broad, undulating plains in the upland. Most areas are 5 to 30 acres in size.

Included with this soil in mapping are long, narrow areas of Brookston silt loam in small drainageways. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. Also included are gently sloping areas, 1 acre to 3 acres in size, on irregularly shaped low rises or in drainageways. The surface layer is very dark grayish brown in some areas north of Wawaka. In a few small areas the surface layer is sandy loam. In places small stones are on the surface.

Wetness is a limitation on this Crosier soil, and drainage is needed. Maintaining tilth and the supply of organic matter are management needs.

This soil is suited to intensive cropping. Most areas are used for corn, soybeans, and wheat and for grasses and legumes for hay and pasture. Some areas are used for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIw–2; woodland group 3o5.

Edwards Series

The Edwards series consists of very poorly drained organic soils that are moderately deep over marl. These nearly level soils are in depressional areas in the upland and on outwash plains. The depressions were formerly ponded areas in which marl and plant remains accumulated over a long period. These soils formed under sedges, cattails, and water tolerant trees, grasses, and shrubs in deposits of partly decomposed organic material and the underlying marl.

In a representative profile the surface layer is 22 inches of very friable, black muck. The next layer is 7 inches of very friable, black muck in many yellowish brown and dark reddish brown herbaceous fibers. The substratum to a depth of about 60 inches is light gray marl and many shell fragments.

Permeability is rapid in the organic material and variable in the marl. The available water capacity is high or very high. The content of organic matter is very high. Runoff is slow. Some areas are ponded. These soils are subject to subsidence when drained. Wetness is a serious limitation. The seasonal high water table is at or near the surface. Soil blowing is a hazard. Trafficability and load-supporting capacity are poor.

Drained areas of these soils are suited to corn, soybeans, sweet corn, mint, onions, potatoes, and many grasses. Undrained areas are suitable for wetland wildlife habitat.

Representative profile of Edwards muck, drained, in a cultivated field, 950 feet north and 2,000 feet west of the southeast corner of sec. 17, T. 34 N., R. 10 E.

Oap—0 to 10 inches; black (10YR 2/1) rubbed sapric material; about 5 percent fiber, no recognizable fibers when rubbed; weak medium granular structure; very friable; 10 percent mineral content; neutral; abrupt smooth boundary.

Oa2—10 to 22 inches; black (10YR 2/1) rubbed sapric material; 10 percent fiber, no recognizable fibers when rubbed; weak very fine granular structure; very friable; 10 percent mineral content; neutral; clear wavy boundary.

Oa3—22 to 29 inches; black (10YR 2/1) rubbed sapric material; about 15 percent fiber, 5 percent fibers rubbed; weak medium and coarse granular structure; very friable; yellowish brown (10YR 5/6) and dark reddish brown (5YR 3/4) herbaceous fibers; mildly alkaline grading to moderately alkaline in lower part; abrupt smooth boundary.

Lca—29 to 60 inches; light gray (10YR 6/1) marl; massive; friable; many shell fragments; many dark brown (7.5YR 4/4) herbaceous fibers in upper 4 inches; strong effervescence; moderately alkaline.

The organic horizon ranges from 16 to 44 inches in thickness. Where the organic material is less than 24 inches thick, the solum is typically neutral or alkaline throughout. Deeper solums are slightly acid or neutral in the upper part and neutral to moderately alkaline in the lower part. The Oa3 horizon generally contains some marl, and the upper part of the Lca horizon typically contains some herbaceous fibers. In some pedons there are thin layers of mineral material other than marl. The shell content of the marl is variable.

Edwards soils are similar to and associated with Palms, Houghton, and Adrian soils. They are underlain by marl, whereas Palms soils are underlain by loamy mineral material and Adrian soils by sandy mineral material. Edwards soils are not so deep as Houghton soils.

Ed—Edwards muck. This soil occupies broad, undrained depressional areas of the uplands and outwash plains. The water table is at or near the surface most of the year. Slopes are 0 to 2 percent. Most areas are 20 to 100 acres in size. The profile of this soil is similar to the one described as representative of the series, but the organic horizon contains more brownish peat and is mixed with the black muck.

Included with this soil in mapping are small areas where the muck is either less than 16 inches or more than 49 inches deep over marl.

Wetness is a serious limitation on this Edwards soil. Drainage outlets are often difficult to obtain in these areas because the water level of adjacent lakes and streams is the same as the level of the water table.

This soil is suitable for wetland wildlife habitat, and it provides some cover for other wildlife. It is not suited to crops. Some areas are used for pasture during dry periods. Limitations are severe for most nonfarm uses. Capability unit Vw–3; woodland group 4w23.

Em—Edwards muck, drained. This soil occupies broad, irregularly shaped depressional areas of the uplands and outwash plains. The water table is at least 2 feet below the surface most of the year. Slopes are 0 to 2 percent. Most areas are 20 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas where the organic soil is either less than 16 inches or more than 44 inches deep over marl. Undrained areas, ½ acre to 2 acres in size, that are too wet for commonly grown crops are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Edwards soil. Drainage has caused subsidence of the muck, and soil blowing is a hazard when the soil is dry. Fire is a hazard because muck readily burns when dry.

This soil is suited to row crops each year. Most areas are used for corn. The soil is well suited to corn and many vegetable crops. Limitations are severe for most nonfarm uses. Capability unit IVw–3; woodland group 4w23.

Fox Series

The Fox series consists of well drained, moderately coarse textured soils that are moderately deep over sand and gravelly sand. These soils formed in medium textured glacial outwash on outwash plains and knolls in the upland. They are nearly level to moderately steep. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 9 inches of dark brown sandy loam. The subsoil is about 26 inches thick. In sequence from the top, it is 5 inches of friable, dark yellowish brown heavy sandy loam; 13 inches of firm, dark brown clay loam; and 8 inches of mostly firm, dark brown sandy clay loam. The substratum to a depth of about 60 inches is brown, stratified sand and gravelly sand.

Permeability and the available water capacity are moderate. The content of organic matter is moderate. Runoff is slow to very rapid. Droughtiness is a limitation.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. The more sloping soils are best suited to hay, pasture, or trees. Because of droughtiness, crops that mature early in the season are best suited.

Representative profile of Fox sandy loam, 0 to 2 percent slopes, in a cultivated field, 150 feet west and 1,420 feet north of the corner of sec. 15, T. 35 N., R. 10 E.

Ap—0 to 9 inches; dark brown (10YR 4/3) sandy loam, pale brown (10YR 6/3) dry; weak fine and medium granular structure; friable; about 7 percent gravel; many roots; slightly acid; abrupt smooth boundary.

B1—9 to 14 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; weak fine and very fine subangular blocky structure; friable; many roots; about 5 percent gravel; slightly acid; abrupt smooth boundary.

B21t—14 to 27 inches; dark brown (7.5YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; 15 percent gravel; many continuous distinct dark brown (10YR 3/3) clay films on faces of peds; medium acid; clear wavy boundary.

B22t—27 to 33 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; 10 percent gravel; many continuous thin dark brown (10YR 3/3) clay films on faces of peds; medium acid; clear wavy boundary.

B3t—33 to 35 inches; dark yellowish brown (10YR 4/4) light sandy clay loam; weak fine and very fine subangular blocky structure; friable; 10 percent fine gravel; many continuous prominent dark brown (10YR 3/3) clay films on faces of peds; neutral; abrupt irregular boundary.

IIC—35 to 60 inches; brown (10YR 5/3) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderate alkaline.

The thickness of the solum and the depth to calcareous sand and gravelly sand range from 24 to 38 inches. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). Some pedons have an A2 horizon of brown (10YR 5/3) sandy loam 2 to 6 inches thick. The B1 horizon is loam in some pedons. The B21t and B22t horizons range from clay loam to gravelly sandy clay loam and contain more gravel in the lower part. Some pedons have a gravelly sandy clay loam B3t horizon. Tongues of the B3t horizon extend 1 foot to 3 feet into the IIC horizon in some pedons. The IIC horizon varies considerably in content of sand and gravel.

Fox soils are associated with Casco and Oshtemo soils. They have a thicker subsoil than Casco soils and a thinner, finer textured subsoil than Oshtemo soils.

FoA—Fox sandy loam, 0 to 2 percent slopes. This nearly level soil is on broad, glacial outwash plains. Areas are irregular in shape and range from 40 to 400 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of a similar soil that is deeper, more acid, and coarser

textured. Circular depressional areas, or potholes, ½ acre to 2 acres in size and having slopes of 2 to 6 percent are identified by spot symbols on the soil map. In some potholes and drainageways, the surface layer is loam and is several feet thick. Also included is a similar moderately well drained soil that has a seasonal high water table at a depth of 3 to 6 feet. This soil is in broad areas along Solomon Creek, near Cosperville and northwest of Ligonier.

Droughtiness on this Fox soil is a limitation, especially for shallow-rooted crops. The soil absorbs water readily. It is easy to work and to keep in good tilth. Runoff is slow. Maintaining the supply of organic matter is a management need.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. A few areas are used for woodland. Limitations are slight for most nonfarm uses. Capability unit IIs–2; woodland group 2o15.

FoB—Fox sandy loam, 2 to 6 percent slopes. This soil occupies long, narrow breaks along drainageways and around potholes and undulating, irregularly shaped knolls on outwash plains and in the upland. Most areas are 5 to 100 acres in size. The profile of this soil is similar to the one described as representative of the series (fig. 10), but the surface layer is lighter in color.

Included with this soil in mapping are a few areas of Casco soils. Areas of less than 2 acres are identified by spot symbols on the soil map. In some potholes and drainageways, the surface layer is loam and is several feet thick. Some small eroded areas are included. Small gravelly areas where pebbles on the surface interfere with tillage are identified by spot symbols on the soil map.

Erosion is a hazard and droughtiness a limitation on this Fox soil. The soil absorbs water readily. It is easy to work and to keep in good tilth. Runoff is medium. Maintaining the supply of organic matter is a management need.

This soil is suitable for row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. A few areas are used for woodland. Limitations are slight for most nonfarm uses. Capability unit IIe–2; woodland group 2o15.

FoC2—Fox sandy loam, 6 to 12 percent slopes, eroded. This soil occupies narrow breaks along drainageways and around potholes and irregularly shaped knolls on outwash plains and in the upland. Slopes are generally less than 150 feet long. Most areas are 5 to 20 acres in size. The profile of this soil is similar to the one described as representative of the series, but about 3 to 5 inches of the surface layer have been removed by erosion. The present surface layer is brown, is a mixture of the surface layer and subsoil, and contains more pebbles than the uneroded soil.

Included with this soil in mapping are many small areas of Casco soils, which are commonly at the crests and at mid slope. Also included are small areas of uneroded Fox soils and small areas of severely eroded soils that have a gravelly surface layer. Steep or very steep, narrow breaks or bluffs are identified by spot symbols on the soil map.

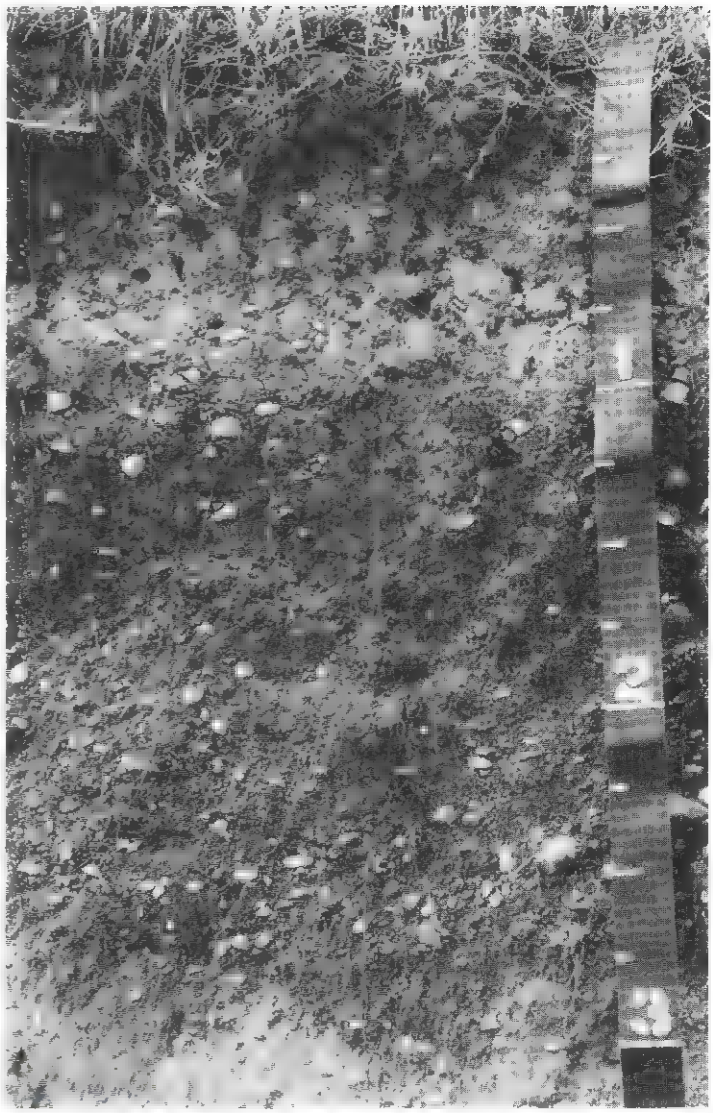

Figure 10.—Profile of Fox sandy loam, 2 to 6 percent slopes.

Erosion is a hazard and droughtiness a limitation on this Fox soil. The soil absorbs water readily and is easy to work. Runoff is rapid. Maintaining the supply of organic matter is a management need.

Row crops are occasionally suited if erosion is controlled. Most areas of this soil are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. Some areas are used for woodland. Limitations are moderate for most nonfarm uses. Capability unit IIIe–13; woodland group 2o15.

FsD2—Fox-Casco sandy loams, 12 to 18 percent slopes, eroded. This mapping unit occupies long, narrow breaks along drainageways and around potholes of outwash plains and irregularly shaped knolls in the upland. Slopes are generally less than 100 feet long. Most areas are 5 to 20 acres in size.

This mapping unit is about 50 percent Fox sandy loam, 30 percent Casco sandy loam, and 20 percent soils

of minor extent, including Boyer loamy sand and Oshtemo loamy sand. The Fox and Casco soils have profiles similar to the ones described as representative of their respective series, but the surface layer is thinner and lighter in color. In addition the Casco soil in this unit has a surface layer of sandy loam. Both soils formed in medium textured outwash and are underlain by sand and gravelly sand.

Fox soils are most common at the top of slopes, near the base of slopes, and in areas where slopes are less than 15 percent. Casco soils are commonly at mid slope in the more sloping areas.

Included with this unit in mapping are areas where the surface layer is gravelly sandy loam or gravelly sandy clay loam. Severely eroded areas ½ acre to 2 acres in size and areas, also ½ acre to 2 acres in size, where gravel on the surface interferes with tillage are identified by spot symbols on the soil map.

Erosion is a hazard and droughtiness a limitation. Runoff is very rapid. The content of organic matter is moderate. Slope limits the use of farm machinery.

This mapping unit is suited to hay and pasture or woodland. Many areas are not well suited, but are used for corn, soybeans, and small grain. Limitations are severe for most nonfarm uses. Capability unit IVe–13; woodland group 2o15.

FsE2—Fox-Casco sandy loams, 18 to 25 percent slopes, eroded. This mapping unit occupies long, narrow breaks along drainageways and around potholes of outwash plains and irregularly shaped knolls and in the upland. Slopes are generally less than 100 feet long. Most areas are 2 to 15 acres in size.

This mapping unit is about 40 percent Fox sandy loam, 35 percent Casco sandy loam, and 25 percent soils of minor extent, including Boyer loamy sand and Oshtemo loamy sand. The Fox and Casco soils have profiles similar to the ones described as representative of their respective series, but the surface layer is thinner. In addition the Casco soil in this unit has a surface layer of sandy loam. Both soils formed in medium textured outwash and are underlain by sand and gravelly sand.

Fox soils are most common at the top of slopes, near the base of slopes, and in areas where slopes are less than 20 percent. Casco soils are common at mid slope in the more sloping areas.

Included with this unit in mapping are areas where the surface layer is gravelly sandy loam or gravelly sandy clay loam. Severely eroded areas ½ acre to 2 acres in size and areas, also ½ acre to 2 acres in size, where gravel on the surface interferes with tillage are identified by spot symbols on the soil map.

Erosion is a hazard and droughtiness a limitation. Runoff is very rapid. Slope severely limits irrigation and farm equipment.

This mapping unit is suited to pasture or woodland. Most areas are used for pasture or woodland or are idle. Some areas are not suited, but are used for corn, soybeans, or small grain. Limitations are severe for most nonfarm uses. Capability unit VIe–3; woodland group 2r2.

Fulton Series

The Fulton series consists of deep, somewhat poorly drained, medium textured soils. These soils are nearly level on flats and gently undulating on plains in the upland and on outwash plains. They formed in fine textured sediment that settled out of slow-moving water in lakebeds. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 8 inches of dark grayish brown silt loam. The subsurface layer is 3 inches of mottled, light brownish gray light silty clay loam. The subsoil is about 32 inches thick. In sequence from the top, it is 15 inches of brown silty clay mottled with light brownish gray and yellowish brown; 13 inches of light brownish gray silty clay mottled with yellowish brown and light olive brown; and 4 inches of grayish brown silty clay mottled with light olive brown. The substratum to a depth of about 60 inches is grayish brown silty clay mottled with light olive brown.

Permeability is slow or very slow, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow. The seasonal high water table fluctuates between depths of 1 foot and 3 feet. Wetness is a limitation.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture.

Representative profile of Fulton silt loam in a cultivated field, 1,600 feet west and 500 feet south of the northeast corner of sec. 16, T. 34 N., R. 11 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium granular structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 11 inches; light brownish gray (10YR 6/2) light silty clay loam; common medium distinct brown (10YR 5/3) mottles and few fine prominent yellowish brown (10YR 5/6) mottles; weak very fine and fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21—11 to 17 inches; brown (10YR 5/3) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles and common medium distinct light brownish gray (10YR 6/2) mottles; moderate fine angular blocky structure; very firm; patchy grayish brown (10YR 5/2) clay films on faces of peds; medium acid; gradual wavy boundary.

B22t—17 to 26 inches; brown (10YR 5/3) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles and many medium distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; very firm; continuous grayish brown (10YR 5/2) clay films on most faces of peds; medium acid; gradual wavy boundary.

B23tg—26 to 39 inches; light brownish gray (2.5Y 6/2) silty clay; common fine distinct yellowish brown (10YR 5/6) mottles and many fine distinct light olive brown (2.5Y 5/4) mottles; moderate coarse prismatic structure parting to moderate fine and medium angular blocky; very fine; dark grayish brown (10YR 4/2) clay films on faces of most peds; neutral; clear wavy boundary.

B3g—39 to 43 inches; grayish brown (2.5Y 5/2) silty clay; moderate medium distinct light olive brown (2.5Y 5/4) mottles; moderate medium prismatic structure parting to moderate angular blocky; very firm; light gray (10YR 7/2) lime nodules; few dark grayish brown (10YR 4/2) clay films on vertical cleavage faces; moderately alkaline; gradual wavy boundary.

C—43 to 60 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct light olive brown (2.5Y 5/6) mottles; massive; very firm; light gray (10YR 7/2)

lime nodules and coatings on cleavage faces; strong effervescence; moderately alkaline.

The solum ranges from 30 to 45 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A2 horizon, if it occurs, is grayish brown (10YR 5/2) or pale brown (10YR 6/3). In some pedons the B21, B22t, and B23t horizons are clay. The C horizon contains thin strata of silt, fine sand, or silty clay loam in some pedons.

Fulton soils are similar to Blount soils and are associated with Toledo soils. They contain more clay in the substratum than Blount soils and do not contain glacial pebbles. They have a lighter colored surface layer and a browner subsoil than Toledo soils.

Fu—Fulton silt loam. This soil is nearly level on irregularly shaped flats and is gently undulating on plains between depressions and knolls. Slopes are 0 to 2 percent. Most areas are 5 to 20 acres in size.

Included with this soil in mapping are long, narrow areas of Toledo silty clay loam in drainageways and in shallow potholes. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. In some areas the surface layer is light silty clay loam, and in a few small areas north of Big Lake the plow layer is fine sandy loam.

Wetness is a serious limitation on this Fulton soil, and drainage is needed. Drainage is restricted by the very slow permeability. Maintaining tilth and the supply of organic matter are management needs.

This soil is suited to intensive cropping if it is drained. Most areas are used for corn, soybeans, and small grain and grasses and legumes for hay and pasture. Heaving is a concern for deep-rooted legumes in some years. A few undrained areas are used for woodland or are idle. Capability unit IIIw–6; woodland group 3o5.

Gilford Series

The Gilford series consists of deep, very poorly drained, moderately coarse textured soils. These soils formed in moderately coarse textured glacial outwash. They occupy broad depressional areas of outwash plains. They are nearly level. The native vegetation was water-tolerant hardwood trees.

In a representative profile the surface layer is 12 inches of very dark gray sandy loam. The subsoil is about 28 inches thick. In sequence from the top, it is 4 inches of friable, gray sandy loam mottled with pale brown and yellowish brown; 12 inches of very friable, light sandy loam mottled with yellowish brown and pale brown; 8 inches of very friable, pale brown sandy loam mottled with dark yellowish brown and light brownish gray; and 4 inches of friable, dark yellowish brown light sandy clay loam mottled with gray. The substratum to a depth of about 60 inches is pale brown, stratified sand and gravelly sand.

Permeability is moderately rapid, and the available water capacity is moderate. The content of organic matter is high. Runoff is very slow. Some areas are ponded. These soils absorb water readily and are easy to work. Wetness is a serious limitation. The seasonal high water table is at or near the surface. In drained areas, droughtiness is a limitation, especially for shallow-rooted crops, during prolonged periods of low rainfall.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suited to pasture or woodland.

Representative profile of Gilford sandy loam in a cultivated field, 150 feet south and 200 feet west of the northeast corner of sec. 5, T. 34 N., R. 8 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) sandy loam, grayish brown (10YR 5/2) dry; weak very fine and fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; very dark gray (10YR 3/1) sandy loam; weak fine and medium granular structure; very friable; slightly acid; clear smooth boundary.

B21g—12 to 16 inches; gray (5Y 5/1) sandy loam; common fine prominent yellowish brown (10YR 5/6) mottles and many fine distinct pale brown (10YR 6/3) mottles; weak fine subangular blocky structure; friable; about 3 percent fine gravel; slightly acid; gradual wavy boundary.

B22g—16 to 28 inches; dark gray (5Y 4/1) light sandy loam; few fine prominent yellowish brown (10YR 5/6) mottles and common fine distinct pale brown (10YR 6/3) mottles; weak fine subangular blocky structure; very friable; about 5 percent fine gravel; neutral; gradual wavy boundary.

B23—28 to 36 inches; pale brown (10YR 6/3) sandy loam; few fine distinct dark yellowish brown (10YR 4/4) mottles and common fine distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; very friable; about 5 percent fine gravel; neutral; clear wavy boundary.

B24—36 to 40 inches; dark yellowish brown (10YR 4/4) light sandy clay loam; many fine prominent gray (10YR 5/1) mottles; moderate medium subangular blocky structure; friable; about 7 percent fine gravel; discontinuous very dark grayish brown (10YR 3/2) organic clay films on some faces of peds and in voids; neutral; abrupt wavy boundary.

IIC—40 to 60 inches; pale brown (10YR 6/3) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 30 to 42 inches in thickness. The B22 and B23 horizons are slightly acid or neutral. The A horizon ranges from 10 to 18 inches in thickness and is black (10YR 2/1) or very dark gray (10YR 3/1). The B22, B23, and B24 horizons contain thin strata of loamy sand. The content of material as fine as sandy clay loam ranges from 0 to 6 percent in the B23 or B24 horizons. In some pedons soft, rounded masses of dark brown (10YR 3/3), strong brown (7.5YR 5/8), or reddish brown (5YR 4/4) sandy loam or light sandy clay loam are in the B23 and B24 horizons. In some pedons the IIC horizon is mainly sand. Thin strata of silt loam or sandy loam are in the IIC horizon in some pedons.

Gilford soils are similar to Sebewa and Rensselaer soils. They have a coarser textured subsoil than those soils.

Gf—Gilford sandy loam. This soil is in broad depressional areas on glacial outwash plains. Slopes are 0 to 2 percent. Areas are irregular in shape and are 10 to 50 acres in size.

Included with this soil in mapping are a few small areas of Brady sandy loam in the slightly higher spots within the depressions and a few small areas where the subsoil is mostly sandy clay loam. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops and areas ½ acre to 5 acres in size where there are reddish brown or yellowish red iron accumulations or nodules are identified by spot symbols on the soil map.

Wetness is a severe limitation on this Gilford soil, and drainage is needed.

This soil is suited to row crops each year. Most areas are used for corn, soybeans, and wheat. A few areas are used for hay or pasture or for woodland. Limitations are severe for most nonfarm uses. Capability unit IIw–4; woodland group 4w21.

Haskins Series

The Haskins series consists of deep, somewhat poorly drained, medium textured soils. These nearly level soils are on flats and in drainageways in the upland and on outwash plains. They formed under mixed hardwood trees in medium textured glacial drift and in the underlying moderately fine textured or fine textured glacial till or sediment.

In a representative profile the surface layer is 8 inches of dark grayish brown loam. The subsurface layer is 3 inches of grayish brown loam mottled with yellowish brown. The subsoil is about 30 inches thick. In sequence from the top, it is 13 inches of fine, grayish brown light clay loam mottled with yellowish brown; 13 inches of very firm, brown light silty clay loam mottled with yellowish brown; and 4 inches of very firm, light brownish gray silty clay mottled with yellowish brown. The substratum to a depth of about 60 inches is grayish brown silty clay mottled with yellowish brown.

Permeability is moderate in the upper part of these soils and slow or very slow in the lower part. The available water capacity is high. The content of organic matter is moderate. Runoff is slow. Wetness is a limitation. Lateral seepage is a concern at the base of slopes. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Haskins loam, 0 to 2 percent slopes, in a cultivated field, 100 feet south and 500 feet east of the northwest corner of sec. 22, T. 34 N., R. 11 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak fine and medium granular structure; friable; numerous roots; neutral; abrupt smooth boundary.

A2g—8 to 11 inches; grayish brown (10YR 5/2) loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium granular structure; friable; numerous roots; neutral; clear smooth boundary.

B21tg—11 to 24 inches; grayish brown (10YR 5/2) light clay loam; common fine distinct yellowish brown (10YR 5/8) mottles; moderate medium subangular blocky structure; firm; few fine pebbles; thin discontinuous dark grayish brown (10YR 4/2) clay films on some faces of peds; numerous roots; medium acid; clear wavy boundary.

IIB21tg—24 to 37 inches; brown (10YR 5/3) light silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; very firm; few fine pebbles; dark gray (10YR 4/1) clay films on most faces of peds; slightly acid; clear wavy boundary.

IIB22tg—37 to 41 inches; light brownish gray (10YR 6/2) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; very firm; dark gray (10YR 4/1) clay films on most faces of peds; neutral; gradual wavy boundary.

IICg—41 to 60 inches; grayish brown (10YR 5/2) silty clay; few fine faint yellowish brown (10YR 5/4) mottles; massive; very firm; strong effervescence; moderately alkaline.

The solum ranges from 30 to 42 inches in thickness. Depth to the IIB21tg horizon ranges from 24 to 40 inches. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). In most pedons in cultivated areas the A2 horizon is mixed with the Ap horizon. Some pedons have a B1 horizon. The B21tg horizon is dominantly clay loam or light clay loam, but ranges to silty clay loam or sandy clay loam. The IIB22tg horizon is silty clay or clay. The IIC horizon is silty clay loam, clay loam, or clay. In places it is glacial till or fine textured or moderately fine textured sediment.

Haskins soils are similar to Crosier and Blount soils. They contain more clay in the lower part of the subsoil and in the substratum than Crosier soils and less clay in the upper part of the subsoil than Blount soils.

HaA—Haskins loam, 0 to 2 percent slopes. This nearly level soil occupies broad, irregularly shaped flats and narrow, winding drainageways of the broad, undulating plains on uplands and outwash plains. Most areas are 3 to 20 acres in size.

Included with this soil in mapping are some small areas of Blount silt loam, small areas of Rawson loam on low rises, and a few small elongated areas of Pewamo silty clay loam in shallow depressions and in drainageways. Some areas of 2 to 5 acres are on irregularly shaped, undulating low rises and slopes along depressions and in drainageways. Erosion is a hazard in these areas, and crop yields are commonly lower. Near Bakerstown and north of Big Lake are broad, irregularly shaped flats between winding depressional areas 3 to 60 acres in size where the surface layer is sandy loam and the upper part of the subsoil is heavy sandy loam or sandy clay loam. A few small areas where slopes are 2 to 4 percent and the surface layer is sandy loam are in narrow drainageways or on low rises. This sandy loam is somewhat droughty for shallow-rooted crops, and yields are lower during prolonged periods of low rainfall. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. In some areas pebbles and cobbles are on the surface and are mixed throughout the upper part of the profile.

Wetness is a limitation on this Haskins soil, and drainage is needed. Maintaining the supply of organic matter and tilth are management needs.

This soil is suited to intensive cropping. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. A few areas are in woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIw–2; woodland group 3o5.

Homer Series

The Homer series consists of somewhat poorly drained, medium textured soils that are moderately deep over sand and gravelly sand. These soils formed in medium textured glacial outwash. They occupy flats on outwash plains. They are nearly level. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is about 8 inches of dark brown loam. The subsurface layer is

about 2 inches of dark grayish brown loam. The subsoil is about 28 inches thick. In sequence from the top, it is 8 inches of firm, yellowish brown heavy loam mottled with grayish brown and dark yellowish brown; 7 inches of firm, light brownish gray sandy clay loam mottled with gray and yellowish brown; 9 inches of firm, brown gravelly sandy clay loam mottled with gray and dark brown; and 4 inches of very friable, dark grayish brown gravelly sandy loam and loamy sand. The substratum to a depth of about 60 inches is brown, stratified sand and gravelly sand.

Permeability and the available water capacity are moderate. The content of organic matter is moderate. Runoff is slow. These soils absorb water readily and are easy to work. Wetness is a limitation. The seasonal high water table fluctuates between depths of 1 foot and 3 feet. Droughtiness is a limitation during prolonged periods of low rainfall.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture and woodland.

Representative profile of Homer loam in a cultivated field, 650 feet east and 575 feet north of the southwest corner of sec. 4, T. 35 N., R. 8 E.

Ap—0 to 8 inches; dark brown (10YR 3/3) loam, pale brown (10YR 6/3) dry; weak fine and medium subangular blocky structure; friable; many fine and medium roots; 10 percent gravel; neutral; abrupt smooth boundary.

A2—8 to 10 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; many medium roots; 10 percent gravel; neutral; clear wavy boundary.

B1t—10 to 18 inches; yellowish brown (10YR 5/4) heavy loam; many fine distinct grayish brown (10YR 5/2) mottles and few fine distinct dark yellowish brown (10YR 3/4) mottles; moderate fine and medium subangular blocky structure; firm; thin grayish brown (10YR 5/2) clay films on faces of most peds; few voids filled with dark brown (10YR 4/3) loam; 12 percent gravel; medium acid; clear wavy boundary.

B21tg—18 to 25 inches; light brownish gray (10YR 6/2) sandy clay loam; common fine distinct gray (10YR 5/1) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; dark grayish brown (10YR 4/2) clay films on faces of most peds; patchy dark brown (10YR 3/3) coatings; about 18 percent gravel; medium acid; clear wavy boundary.

B22t—25 to 34 inches; brown (10YR 4/3) gravelly sandy clay loam; many medium distinct gray (10YR 5/1) mottles and common fine distinct dark brown (7.5YR 4/4) mottles; moderate medium and coarse subangular blocky structure; firm; dark grayish brown (10YR 4/2) clay films on faces of most peds; dark brown (10YR 3/3) coatings on some faces of peds and fillings in voids; many iron- and manganese-oxide concretions; 25 percent gravel; medium acid; clear wavy boundary.

IIB3—34 to 38 inches; dark grayish brown (2.5YR 4/2) stratified gravelly sandy loam and loamy sand; weak coarse subangular blocky structure; very friable; 20 percent gravel; mildly alkaline; clear wavy boundary.

IIC—38 to 60 inches; brown (10YR 5/3) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to the IIC horizon range from 28 to 40 inches. The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or dark brown (10YR 3/3 and 4/3). Some pedons do not have an A2 horizon or a IIB3 horizon. The B21tg and B22t horizons are clay loam, sandy clay loam, or gravelly sandy clay loam. The IIC horizon is stratified gravelly sand and sand.

Homer soils are similar to Brady and Whitaker soils. They contain more clay in the subsoil than Brady soils and have a coarser textured substratum than Whitaker soils.

Hh—Homer loam. This soil is on broad irregularly shaped flats between drainageways and depressions of the outwash plains. Slopes are 0 to 2 percent. Most areas are 10 to 100 acres in size.

Included with this soil in mapping are small areas of Sebewa loam in narrow, elongated drainageways and depressions. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. In a few places the subsoil extends to a depth of 48 inches. Also included are a few areas near Solomon Creek where the surface layer is sandy loam, gravelly loam, or gravelly sandy loam. In some areas the upper part of the substratum is loamy sand and gravelly loamy sand.

Wetness and the seasonal high water table, which fluctuates between depths of 1 foot and 3 feet, are limitations on this Homer soil. Droughtiness is a limitation during prolonged periods of below average or low rainfall. Maintaining the supply of organic matter is a management need.

This soil is suited to row crops. Most areas are used for corn, soybeans, and wheat. Many undrained areas are used for pasture or woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIw–6; woodland group 3w20.

Houghton Series

The Houghton series consists of deep, very poorly drained, organic soils. These nearly level soils occupy depressional areas of the upland and outwash plains. The depressions were formerly marshy areas in which plant remains accumulated over a long period. The soils formed in deep deposits of partly decomposed organic material. The native vegetation was sedges, cattails, and water-tolerant trees, shrubs, and grasses.

In a representative profile the surface layer is 10 inches of black muck. The next layer is 8 inches of very friable, black muck and very dark brown herbaceous fibers. The lower layer is 42 inches of very friable, black muck and brown and pale brown herbaceous fibers.

Permeability is rapid, and the available water capacity is very high. The content of organic matter is very high. Runoff is very slow. Some areas are ponded. These soils are subject to subsidence when drained. Wetness is a severe limitation. The seasonal high water table is at or near the surface. Soil blowing is a hazard. Trafficability and load-supporting ability are poor.

Drained areas of these soils are suited to corn, soybeans, sweet corn, mint, onions, and potatoes and to many grasses for pasture (fig. 11). Undrained areas are suitable for wetland wildlife habitat.

Representative profile of Houghton muck, drained, in a cultivated field, 500 feet east and 100 feet north of the southwest corner of sec. 14, T. 34 N., R. 10 E.

Oap—0 to 10 inches; black (10YR 2/1) rubbed sapric material; about 5 percent fiber, no recognizable fiber when rubbed; moderate fine granular structure; very friable; 10 percent mineral content; many roots; slightly acid; abrupt smooth boundary.

Oa2—10 to 18 inches; black (10YR 2/1) rubbed sapric

Figure 11.—Houghton muck (center) has been drained and is used for corn. Slopes in the foreground are seeded to pasture grasses.

material; about 15 percent fiber, 5 percent fiber rubbed; moderate fine and medium granular structure; very friable; 10 percent mineral content; many roots; fine partly decomposed herbaceous fibers, very dark brown (10YR 2/2) rubbed; medium acid; clear smooth boundary.

Oa3—18 to 36 inches; black (10YR 2/1) rubbed sapric material; about 10 percent fiber, less than 5 percent fiber rubbed; weak medium subangular blocky structure; very friable; 5 percent mineral content; brown (10YR 5/3) partly decomposed herbaceous fibers; medium acid; clear wavy boundary.

Oa4—36 to 60 inches; black (10YR 2/1) rubbed sapric material; about 15 percent fiber, 5 percent fiber rubbed; massive; very friable; 10 percent mineral content; pale brown (10YR 6/3) fine herbaceous fibers; medium acid.

The organic layers are more than 51 inches thick. The Oap and Oa2 horizons are black (10YR 2/1 or 5YR 2/1) or very dark brown (10YR 2/2). Reaction of the surface layer and subsurface layer ranges from neutral to strongly acid. A few herbaceous or woody fibers are in the Oa2 and Oa3 horizons. In some pedons a few woody fragments of partly decomposed logs and branches are in the lower part. In most pedons the content of fibers to a depth of 48 inches is less than 10 percent after rubbing.

Houghton soils are associated with Edwards, Adrian, and Palms soils. They have a deeper organic layer than those soils.

Hm—Houghton muck. This soil occupies broad irregularly shaped depressions of the uplands and outwash plains. Many of the larger areas are adjacent to lakes, and the water table is at or near the surface most of the year. Slopes are 0 to 2 percent. Most areas are 5 to 150 acres in size. The profile of this soil is similar to the one described as representative of the series, but the organic material has more numerous brownish peat fragments.

Included with this soil in mapping are some small areas where the organic soil is less than 50 inches deep over sandy material or marl. A narrow strip of muck, less than 50 inches thick, is around the edge of most areas. In some depressions and potholes in the upland, the organic material is 16 to 40 inches deep over loamy mineral soil material. In some areas the organic material below the surface layer is brownish peat. In others partly decomposed logs and tree branches are in the muck layer.

Wetness is a very severe limitation on this Houghton soil. Drainage outlets are often not available when the water level of adjacent lakes and streams is the same as the level of the water table. Fire is a hazard because muck burns readily when dry.

This soil is used for wetland wildlife habitat and provides cover and food for wildlife. Some areas have been cultivated, but because of subsidence of the muck they are too wet for most crops. Some of these areas are used for pasture during dry periods. Limitations are severe for most nonfarm uses. Capability unit Vw–3; woodland group 4w23.

Ho—Houghton muck, drained. This soil occupies broad depressional areas of the uplands and outwash plains. The water table is at least 2 feet below the surface most of the year. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 100 acres in size. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas where organic material is less than 50 inches deep over sandy or loamy mineral material or marl. These areas

commonly occur as narrow strips around the edge of Houghton muck. Also included are areas of Wallkill silt loam around the edges of depressions where loamy material from eroded areas has been deposited over the muck. In a few places thin layers of mineral material are in the muck. In some areas the organic material below the surface layer is peat. Undrained areas ½ acre to 2 acres in size and areas ½ acre to 5 acres in size where there are considerable iron-oxide nodules or concretions are identified by spot symbols on the soil map. Areas ½ acre to 2 acres in size that are covered with water most of the year are also identified by spot symbols.

Wetness is a severe limitation. Soil blowing is a hazard when this Houghton soil is dry. Drainage has caused subsidence of the muck. Fire is a hazard because muck burns readily when dry.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, or pasture. Some drained areas adjacent to crop fields are woodland. Limitations are severe for most nonfarm uses. Capability unit IIIw–8; woodland group 4w23.

Lake Borders

La—Lake borders are deposits of stratified coarse textured to fine textured, calcareous soil material. They are exposed because the lake level has been lowered several feet in the past 50 to 75 years. In some places a few clam shells are on the surface. In others gravel and cobbles are mixed with the soil material or are on the surface. The soil material adjacent to the existing lakes contains more clayey strata, and areas farther back and at higher elevations contain more sandy strata. The present vegetation is mainly cottonwood and sycamore trees and a sparse growth of grasses and weeds.

Sandy areas 2 to 10 acres in size that have deposits of fine sand several feet thick are identified by spot symbols on the soil map. In these areas the seasonal high water table fluctuates between depths of 2 and 4 feet.

Lake borders are used mainly for housing developments or are idle. The seasonal high water table is at or near the surface. Permeability is extremely variable. Wetness is a severe limitation. The water table restricts the operation of septic tank filter fields. Limitations are severe for most nonfarm uses. Not assigned to a capability unit or woodland group.

Marl Beds

Ma—Marl beds are very poorly drained areas where a muck or loamy mineral surface layer is less than 12 inches deep over marl. They occur in depressional areas, commonly near lakes. They formed under sedges and water-tolerant grasses, shrubs, and trees. In most areas, some light gray marl has been mixed with the surface layer by cultivation or by burrowing animals. The marl has a variable content of calcium carbonate. It is used for lime in some parts of the county.

Permeability and the available water capacity are variable. The content of organic matter is high or very high. Runoff is very slow. Some areas are ponded.

Marl beds are not well suited to most crops because of the serious wetness limitation and the high pH value, but reed canarygrass can be grown. The seasonal high water table is at a depth of less than 1 foot, and the pH value is commonly 7.5 or higher. Marl beds are suited to and are important for wetland wildlife habitat. They also provide some cover and food for other wildlife. Limitations are severe for most nonfarm uses. Capability unit VIw–1; not assigned to a woodland group.

Marsh

Mb—Marsh is covered with shallow water most of the time. It is around the edges of permanent bodies of water and in undrained depressions. The material under the water is variable, but is mainly organic material underlain by mineral material. Some areas have no vegetation, while other areas have cattails, reeds, sedges, and water-tolerant shrubs and trees.

In some areas Marsh is dry for short periods during the summer. It has little value for crops, pasture, or woodland, but is suitable for wetland wildlife habitat. Not assigned to a capability unit or woodland group.

Martinsville Series

The Martinsville series consists of deep, well drained. moderately coarse textured soils. These soils formed in stratified, medium textured and moderately coarse textured glacial outwash material. They occupy outwash plains and knolls in the upland. They are gently sloping. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 8 inches of brown fine sandy loam. The subsurface layer is 4 inches of brown fine sandy loam. The subsoil is about 32 inches thick. In sequence from the top, it is 6 inches of friable, brown heavy sandy loam; 21 inches of firm, dark brown sandy clay loam; and 5 inches of friable, yellowish brown loam. The substratum to a depth of about 60 inches is yellowish brown, stratified sandy loam, fine sand, silt, and silt loam.

Permeability is moderate, and the available water capacity is high. The content of organic matter is moderate. Runoff is medium. Erosion is a hazard. Droughtiness is a limitation, especially for shallow-rooted crops, during prolonged periods of below average or low rainfall.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture.

Representative profile of Martinsville fine sandy loam, 2 to 6 percent slopes, in a cultivated field, 600 feet west and 700 feet south of the northeast corner of sec. 9, T. 35 N., R. 9 E.

Ap—0 to 8 inches; brown (10YR 4/3) fine sandy loam; weak fine and very fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A2—8 to 12 inches; brown (10YR 5/3) fine sandy loam; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

B1t&A—12 to 18 inches; brown (7.5YR 4/4) heavy sandy loam; weak fine subangular blocky structure; friable; discontinuous dark brown (7.5YR 3/2) clay films on some faces of peds; medium acid; gradual wavy boundary.

B21t—18 to 28 inches; dark brown (7.5YR 4/4) sandy clay

loam; moderate medium subangular blocky structure; firm; thin dark brown (7.5YR 3/2) clay films on most faces of peds; medium acid; gradual wavy boundary.

B22t—28 to 39 inches; dark brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; dark brown (7.5YR 3/2) clay films on faces of peds; medium acid; clear wavy boundary.

B3—39 to 44 inches; yellowish brown (10YR 5/6) loam; weak coarse subangular blocky structure; friable; discontinuous dark brown (10YR 4/3) clay films on vertical faces of peds; neutral; clear wavy boundary.

IIC—44 to 60 inches; yellowish brown (10YR 5/4) stratified sandy loam, fine sand, silt, and silt loam; massive; very friable; strong effervescence; moderately alkaline.

The solum ranges from 40 to 52 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). Because of cultivation, the A2 horizon is generally mixed with the Ap horizon. The B21t and B22t horizons are dark yellowish brown (10YR 4/4 and 3/4) or dark brown (7.5YR 4/4). They are typically clay loam or sandy clay loam, but some subhorizons range to loam or heavy sandy loam. The IIC horizon is dominantly fine sand and silt and minor amounts of silt loam, loam, sandy loam, and sandy clay loam.

Martinsville soils are similar to Metea and Riddles soils. They contain more clay in the upper part of the B horizon than Metea soils. They contain less gravel throughout the solum and have a coarser substratum than Riddles soils.

MdB—Martinsville fine sandy loam, 2 to 6 percent slopes. This gently sloping soil occupies irregularly shaped knolls and long, narrow breaks along drainageways of the outwash plains and uplands. Slopes are convex. Areas are irregular in shape, and most are 3 to 15 acres in size.

Included with this soil in mapping are areas on the top of knolls and ridges, 2 to 5 acres in size, where slopes are less than 2 percent. Runoff is slow in these areas, and the hazard of erosion is slight. In some areas the surface layer is loam, and in others the subsoil is mostly loam and heavy fine sandy loam.

Erosion is a hazard on this Martinsville soil. Droughtiness is a limitation for shallow-rooted crops during prolonged periods of low rainfall. The soil absorbs water readily and is easy to work. Maintaining the supply of organic matter is a management need.

This soil is suited to row crops if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay and pasture. Limitations are slight for most nonfarm uses. Capability unit IIe–11; woodland group 1o1.

Metea Series

The Metea series consists of deep, well drained, coarse textured soils. These soils formed in coarse textured glacial drift and in the underlying medium textured or moderately fine textured glacial till. They occupy knolls in the uplands. They are gently sloping. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 9 inches of dark brown loamy fine sand. The subsoil is about 39 inches thick. In sequence from the top, it is 13 inches of very friable, yellowish brown loamy fine sand; 11 inches of loose, yellowish brown medium sand and strong brown loamy sand bands; 4 inches of very friable, yellowish brown sandy loam; and 11 inches of firm, dark yellowish brown clay loam. The substratum to a depth of about 60 inches is brown loam.

Permeability is very rapid in the upper part of the soils and moderate in the lower part. The available water capacity is moderate. The content of organic matter is moderate. Droughtiness is a limitation for shallow-rooted crops. Erosion and soil blowing are hazards. Trafficability for tillage machinery is poor.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture.

Representative profile of Metea loamy fine sand, 2 to 6 percent slopes, in a cultivated field, 450 feet east and 1,415 feet north of the southwest corner of sec. 29, T. 35 N., R. 10 E.

Ap—0 to 9 inches; dark brown (10YR 3/3) loamy fine sand, light brownish gray (10YR 6/2) dry; weak very fine granular structure; very friable; few fine pebbles; medium acid; abrupt smooth boundary.

B21—9 to 22 inches; yellowish brown (10YR 5/4) loamy fine sand; weak very fine granular structure; very friable; few voids filled with dark brown (10YR 3/3) loamy fine sand in upper part; few fine pebbles; medium acid; gradual wavy boundary.

B22—22 to 33 inches; yellowish brown (10YR 5/6) medium sand; single grained; loose; 2 to 4 inches of strong brown (7.5YR 5/6) loamy sand bands, ¼ to 1 inch thick; few fine pebbles; medium acid; clear wavy boundary.

B23t—33 to 37 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; very friable; dark yellowish brown (10YR 4/4) clay films on some faces of peds and on clay bridges between sand grains; few fine pebbles; medium acid; clear wavy boundary.

IIB24t—37 to 48 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium and coarse subangular blocky structure; firm; few fine pebbles; dark brown (10YR 3/3) clay films on many faces of peds; slightly acid grading to neutral in lower part; clear wavy boundary.

IIC—48 to 60 inches; brown (10YR 5/3) loam; massive; friable; 10 percent fine gravel; strong effervescence; moderately alkaline.

The solum ranges from 40 to 56 inches in thickness. The coarse textured overburden ranges from 20 to 40 inches in thickness. The B21 and B22 horizons are loamy fine sand or sand. The Ap and B2 horizons are 1 to 3 percent gravel. The Ap horizon ranges from dark grayish brown (10YR 4/2) to dark brown (10YR 3/3 and 4/3). Some pedons have an A2 horizon of grayish brown (10YR 5/2) or brown (10YR 5/3) loamy fine sand 1 inch to 3 inches thick. A loamy fine sand or sand B1 horizon is in some pedons. The IIB horizon is sandy clay loam or clay loam. The IIC horizon is loam, clay loam, or silty clay loam. Thin loamy sand lamellae in the upper part of the subsoil of these soils are not within the defined range of the series. This difference, however, does not alter use or management.

Metea soils are associated with Riddles and Chelsea soils. They are coarser textured in the surface layer and the upper part of the subsoil than Riddles soils. In contrast with Chelsea soils, they are not sandy in the lower part of the subsoil and in the substratum.

MeB—Metea loamy fine sand, 2 to 6 percent slopes. This gently sloping soil is on knolls in the upland. Slopes are convex. Areas are irregular in shape, and most are 2 to 200 acres in size.

Included with this soil in mapping are narrow, elongated areas of Aubbeenaubbee fine sandy loam in drainageways; areas 1 acre to 3 acres in size on the top of knolls and ridges where slopes are less than 2 percent; small areas of Chelsea fine sand; and a few narrow, elongated areas 1 acre to 3 acres in size where slopes are 6 to 12 percent. The moderately sloping areas are on breaks along depressions or drainageways and are generally less than 100 feet wide. Also included are

a few small areas where the coarse textured overburden is only 12 to 20 inches thick.

Erosion and soil blowing are hazards on this Metea soil. Droughtiness is a limitation, especially for shallow-rooted crops. Runoff is slow.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Limitations are slight or moderate for most nonfarm uses. Capability unit IIIe–13; woodland group 2s15.

Miami Series

The Miami series consists of deep, well drained, moderately fine textured and medium textured soils. These soils formed in medium textured glacial till. They occupy broad flats, knolls, ridges, and breaks along drainageways and depressions in the upland. They are nearly level to moderately steep. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 8 inches of dark grayish brown loam. The subsurface layer is 3 inches of dark grayish brown loam. The subsoil is about 27 inches thick. In sequence from the top, it is 3 inches of friable, brown light clay loam; 12 inches of firm, dark yellowish brown clay loam; 9 inches of firm, yellowish brown clay loam; and 3 inches of friable, brown light clay loam. The substratum to a depth of about 60 inches is pale brown loam.

Permeability is moderate in the subsoil and moderate to moderately slow in the underlying material. The available water capacity is high. The content of organic matter is moderate or low. Erosion is a hazard on sloping soils. Runoff is slow to very rapid. Maintaining the supply of organic matter is a management need.

Where slopes are 0 to 12 percent, these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Where slopes are more than 12 percent, the soils are best suited to hay, pasture, or woodland.

Representative profile of Miami loam, 2 to 6 percent slopes, eroded, in a cultivated field, 1,200 feet west and 150 feet north of the southeast corner of sec. 32, T. 35 N., R. 10 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; moderate medium and fine granular structure; friable; few pebbles and small stones; neutral; abrupt smooth boundary.

A2—8 to 11 inches; dark grayish brown (10YR 4/2) loam; weak medium platy structure parting to moderate fine granular; friable; few pebbles; slightly acid; clear smooth boundary.

B1—11 to 14 inches; brown (10YR 5/3) light clay loam; moderate fine subangular blocky structure; friable; few pebbles and small stones; medium acid; clear wavy boundary.

B21t—14 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular and angular blocky structure; firm; few pebbles and small stones; dark brown (10YR 3/3) clay films on faces of most peds; medium acid; gradual wavy boundary.

B22t—26 to 35 inches; yellowish brown (10YR 5/4) clay loam; moderate medium and coarse subangular blocky structure; firm; few pebbles and small stones; dark brown (10YR 3/3) clay films on faces of most peds; medium acid; clear wavy boundary.

B3t—35 to 38 inches; brown (10YR 5/3) light clay loam; weak coarse subangular blocky structure; friable; few pebbles and few small stones; vertical dark brown (10YR 3/3) clay films on cleavage faces of most peds; neutral grading to mildly alkaline in lower part; clear irregular boundary.

C—38 to 60 inches; pale brown (10YR 6/3) loam; massive; friable; few pebbles and few small stones; brown (7.5YR 4/4) clay flows on a few vertical cleavage faces; strong effervescence; moderately alkaline.

The solum ranges from 28 to 42 inches in thickness. Coarse fragments, mainly cobbles and pebbles, are less than 10 percent by volume. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3) loam unless severely eroded. It is brown (10YR 5/3 and 4/3) or yellowish brown (10YR 5/4) clay loam or light clay loam in severely eroded areas. The A2 horizon is brown (10YR 5/3) or light yellowish brown (10YR 6/4). In some pedons it does not occur, and in others it is mixed with the Ap horizon by cultivation. Some pedons do not have a B1 horizon. The B21t and B22t horizons are dominantly clay loam and lesser layers of heavy loam, silty clay loam, and sandy clay loam. The C horizon is loam or light clay loam.

Miami soils are similar to Morley, Rawson, and Riddles soils. They are coarser textured than Morley soils. They are coarser textured in the lower part of the subsoil and in the substratum than Rawson soils and have a thinner solum than Riddles soils.

MfB2—Miami loam, 2 to 6 percent slopes, eroded. This soil occupies irregularly shaped ridgetops or knolls and long, narrow breaks along drainageways and depressions in the upland. Slopes are convex. Most areas are 5 to 80 acres in size. The profile of this soil is the one described as representative of the series (fig. 12).

Included with this soil in mapping are small areas of Crosier loam in narrow drainageways. There are small areas of Riddles soils. Severely eroded areas ½ acre to 2 acres in size are identified by spot symbols on the soil map. In some uneroded areas, especially those in woodland, nearly all the surface layer remains. Areas ¼ acre to 2 acres in size where small stones at or near the surface seriously interfere with tillage are identified by spot symbols on the soil map.

Erosion is a hazard on this Miami soil. Runoff is rapid. Maintaining tilth is a management need.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. A few areas are used for woodland. Limitations are slight or moderate for most nonfarm uses. Capability unit IIe–1; woodland group 1o1.

MfC2—Miami loam, 6 to 12 percent slopes, eroded. This soil occupies irregularly shaped knolls and long, narrow breaks along drainageways and depressions in the upland. Slopes are generally convex and less than 200 feet long. Most areas are 3 to 600 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the surface layer is somewhat lighter in color. The plow layer is a mixture of the surface layer and the brown upper part of the subsoil.

Included with this soil in mapping are small areas of Riddles sandy loam. In a few small areas of Miami soil the surface layer is sandy loam. Severely eroded areas ½ acre to 2 acres in size are identified by spot symbols on the soil map. The lower part of the substratum is sand and gravelly sand below a depth of 4 to 12 feet in some areas. These areas are 1 acre to 3 acres in size and are on narrow breaks along well

Figure 12.—**Profile of Miami loam, 2 to 6 percent slopes, eroded.**

drained depressions north of Ligonier and Sylvan Lake. Also included are some small areas on top of knolls where slopes are 2 to 6 percent.

Erosion is a hazard on this Miami soil. Maintaining tilth is a management need.

This soil is suited to occasional row crops if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay and pasture. A few areas are used for woodland. Limitations are moderate for most nonfarm uses. Capability unit IIIe–1; woodland group 1o1.

MfD2—Miami loam, 12 to 18 percent slopes, eroded. This soil occupies irregularly shaped knolls and long, narrow breaks along drainageways and depressions in the upland. Slopes are generally less than 100 feet long. Most areas are 5 to 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the surface layer is lighter in color. The plow layer is a mixture of the surface layer and the brown upper part of the subsoil.

Included with this soil in mapping are small areas where slopes are 6 to 12 percent. Severely eroded areas ½ acre to 2 acres in size and a few gullies 1 foot to 2 feet or more deep are identified by spot symbols on the soil map. In some uneroded areas, especially those in woodland, nearly all the surface layer remains.

Erosion is a serious hazard and slope a limitation on this Miami soil. Runoff is very rapid. Maintaining tilth is a management need.

Some areas of this soil can be used for corn, soybeans, and small grain if erosion is controlled. The soil is better suited to hay, pasture, and woodland. Limitations are severe for most nonfarm uses. Capability unit IVe–1; woodland group 1o1.

MfE2—Miami loam, 18 to 25 percent slopes, eroded. This soil occupies irregularly shaped knolls and long, narrow breaks along streams and depressions in the upland. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the surface layer is lighter in color. The plow layer is a mixture of the surface layer and the brown upper part of the subsoil.

Included with this soil in mapping are small areas where slopes are 12 to 18 percent and a few areas where slopes are more than 25 percent. Severely eroded areas ½ acre to 2 acres in size are identified by spot symbols on the soil map. In some uneroded areas, especially those in woodland, nearly all the surface layer remains. Gullies 1 foot to 2 feet or more deep are identified by spot symbols on the soil map.

Erosion is a serious hazard and slope a limitation on this Miami soil. Runoff is very rapid. Maintaining tilth is a management need.

Most areas are used for pasture or woodland. A few areas are used for crops or are idle. Limitations are severe for most nonfarm uses. Capability unit VIe–1; woodland group 1r2.

MgC3—Miami clay loam, 6 to 12 percent slopes, severely eroded. This soil occupies irregularly shaped knolls and long, narrow breaks along drainageways and depressions in the upland. Slopes are commonly less than 200 feet long. Most areas are 2 to 30 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the plow layer is mostly brown clay loam.

Included with this soil in mapping are small moderately eroded areas where the plow layer is a mixture of the original surface layer and the upper part of the subsoil and a few small areas where slopes are 12 to 18 percent. In a few places the moderately alkaline substratum is exposed at the surface. Gullies 1 foot to 2 feet or more deep are identified by spot symbols on the soil map. Also included are a few uneroded areas that are used for woodland.

Erosion is a serious hazard on this Miami soil. The soil has poor tilth and is difficult to work. It is sticky when wet and hard and cloddy when dry. Productivity is commonly low. Runoff is rapid. Maintaining tilth is a management need.

This soil is well suited to hay, pasture, small grain, or woodland. Most areas are used for corn, soybeans,

or for grasses and legumes for hay or pasture; Limitations are moderate for most nonfarm uses. Capability unit IVe–1; woodland group 1o1.

MgD3—Miami clay loam, 12 to 18 percent slopes, severely eroded. This soil occupies irregularly shaped knolls and long, narrow breaks along drainageways and depressions in the upland. Slopes are generally less than 100 feet long. Most areas are 2 to 25 acres in size. The profile of this soil is similar to the one described as representative of the series, but most of the surface layer and, in places, part of the subsoil have been removed by erosion. The plow layer is mainly the upper part of the subsoil.

Included with this soil in mapping are small moderately eroded areas where the plow layer is a mixture of the original surface layer and the upper part of the subsoil, some small areas where slopes are 6 to 12 percent, and some larger areas where slopes are 18 to 30 percent. The moderately alkaline substratum is exposed at the surface in a few places. Gullies 1 foot to 2 feet or more deep are identified by spot symbols on the soil map. Also included are some areas of woodland where the surface layer is uneroded.

Erosion is a serious hazard and slope a limitation on this Miami soil. The soil has poor tilth and is difficult to work. It is sticky when wet and hard and cloddy when dry. Productivity is commonly low. Runoff is very rapid. Maintaining tilth is a very important management need.

This soil is well suited to hay, pasture, and woodland. Most areas are used for pasture or hay or are idle. A few areas are used occasionally for corn, soybeans, and small grain. Limitations are severe for most nonfarm uses. Capability unit VIe–1: woodland group 1o1.

MhA—Miami loam, gravelly substratum, 0 to 2 percent slopes. This soil is on broad flats in the upland. Areas are large and irregular in shape and re between shallow, narrow and elongated, slightly depressed areas and potholes. Most are 50 to 500 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is somewhat darker in color and thicker and the soil is underlain with sand and gravelly sand below a depth of 4 feet.

Included with this soil in mapping are small, elongated depressional areas and potholes of Parr loam. Also included are small, narrow breaks along depressions and around potholes where slopes are 2 to 6 percent. In some areas the solum is 42 to 54 inches thick. Potholes ½ acre to 2 acres in size are identified by spot symbols on the soil map.

Runoff is slow. Maintaining tilth is a management need.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, and small grain. Limitations are slight or moderate for most nonfarm uses. Capability unit I–1; woodland group 1o1.

MhB2—Miami loam, gravelly substratum, 2 to 6 percent slopes, eroded. This soil occupies long, narrow breaks around shallow potholes and along drainageways and depressions and irregularly shaped knolls of the upland. Slopes are generally less than 100 feet long. Most areas are 2 to 10 acres in size. This soil has a profile similar to the one described as representative of the series, but it is underlain by sand and gravelly sand below a depth of 4 feet.

Included with this soil in mapping are small areas of Parr loam in potholes and elongated depressional areas. In some moderately eroded areas the plow layer is a mixture of the surface layer and the brown upper part of the subsoil.

Erosion is a hazard on this Miami soil. Runoff is rapid. Maintaining tilth is a management need.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain. A few areas are used for hay and pasture. Limitations are slight or moderate for most nonfarm uses. Capability unit IIe–1; woodland group 1o1.

Milford Series

The Milford series consists of deep, nearly level, poorly drained, moderately fine textured soils. They formed in moderately fine textured and fine textured sediment that settled out of still water. They occupy flats and depressions of the uplands and outwash plains. The native vegetation was water-tolerant hardwood trees.

In a representative profile the surface layer is 11 inches of very dark gray silty clay loam and light silty clay. The subsoil is about 38 inches thick. In sequence from the top, it is 5 inches of very firm, dark gray silty clay loam; 10 inches of very firm, dark gray silty clay mottled with yellowish brown and reddish brown; 7 inches of very firm, dark gray silty clay mottled with yellowish brown; 11 inches of very firm, gray silty clay mottled with reddish brown and brown; and 5 inches of very firm, gray light silty clay mottled with yellowish brown. The substratum to a depth of about 63 inches is gray silty clay loam and thin strata of silt loam, sandy loam, and silty clay mottled with yellowish brown.

Permeability is moderately slow, and the available water capacity is high. The content of organic matter is high. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture and woodland.

Representative profile of Milford silty clay loam in a cultivated field, 920 feet south and 225 feet east of the center of sec. 4, T. 34 N., R. 11 E.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate very fine angular blocky and subangular blocky structure; firm; many roots; neutral; abrupt smooth boundary.

A12—7 to 11 inches; very dark gray (10YR 3/1) light silty clay, grayish brown (2.5Y 5/2) dry; moderate very fine angular blocky and subangular blocky structure; firm; many roots; neutral; clear smooth boundary.

B1g—11 to 16 inches; dark gray (10YR 4/1) silty clay loam; moderate fine and medium angular blocky structure; very firm; few roots; thin very dark gray (10YR 3/1) organic coatings; neutral; clear smooth boundary.

B21g—16 to 26 inches; dark gray (5Y 4/1) silty clay; common fine prominent reddish brown (5YR 4/4) mottles and few fine distinct yellowish brown (10YR 5/4) mottles; moderate medium and coarse angular

blocky structure; very firm; thin very dark gray (10YR 3/1) clay and organic coatings on some faces of peds; few iron- and manganese-oxide concretions; neutral; gradual smooth boundary.

B22g—26 to 33 inches; dark gray (5Y 4/1) silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium and coarse prismatic structure parting to moderate medium and coarse angular blocky; very firm; few thin dark gray (5Y 4/1) clay and organic coatings on some vertical faces of peds; neutral; gradual smooth boundary.

B23g—33 to 44 inches; gray (5Y 5/1) silty clay; few fine prominent reddish brown (5YR 4/4) mottles and many fine prominent brown (7.5YR 4/4) mottles; moderate medium and coarse prismatic structure parting to moderate medium and coarse angular blocky; very firm; few iron- and manganese-oxide concretions; neutral; gradual smooth boundary.

B3g—44 to 49 inches; gray (5Y 5/1) light silty clay; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium and coarse prismatic structure parting to moderate coarse angular blocky and subangular blocky; very firm; neutral; gradual smooth boundary.

C—49 to 63 inches; gray (5Y 5/1) silty clay loam with thin strata of silt loam, sandy loam, and silty clay; few fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; strong effervescence; mildly alkaline.

The solum ranges from 40 to 55 inches in thickness. The Ap and A12 horizons are 11 to 15 inches thick and are very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or black (10YR 2/1). The B21g, B22g, and B23g horizons are heavy silty clay loam, silty clay, or light silty clay. The C horizon is dominantly silty clay loam and lesser amounts of silty clay, silt loam, loam, and fine sandy loam.

Milford soils are similar to Toledo and Pewamo soils. They have a coarser textured substratum than Toledo soils. Pewamo soils contain pebbles in the solum, whereas Milford soils do not.

Mn—Milford silty clay loam. This soil occupies broad flats and depressions of the uplands and outwash plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 5 to 60 acres in size.

Included with this soil in mapping are areas where the surface layer is silt loam. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. The dark surface layer is 8 to 11 inches thick in places. In some areas along Little Cedar Creek, sand and gravelly sand strata are below a depth of 42 inches. Also included are small areas of Blount silt loam on low rises and adjacent flats and a few narrow, elongated areas of Washtenaw silt loam at the base of adjacent eroded slopes.

Wetness is a serious limitation on this Milford soil. Drainage is needed if the soil is cropped. The soil becomes hard and cloddy if worked when wet. Maintaining tilth is a management need.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Some undrained areas are used for woodland. Capability unit IIw–1; woodland group 2w11.

Morley Series

The Morley series consists of deep, moderately well drained, or well drained, medium textured and moderately fine textured soils. These soils formed in moderately fine textured glacial till. They occupy knolls, ridges, and breaks along drainageways and depressions in the upland. They are gently sloping to moderately steep. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 7 inches of dark grayish brown silt loam. The subsurface layer is 2 inches of dark grayish brown silt loam. The subsoil is about 30 inches thick. In sequence from the top, it is 3 inches of firm, yellowish brown heavy clay loam; 18 inches of very firm, brown clay mottled with yellowish brown; and 9 inches of firm, brown clay loam mottled with yellowish brown. The substratum to a depth of about 60 inches is brown clay loam mottled with yellowish brown and light brownish gray.

Permeability is slow, and the available water capacity is high. The content of organic matter is mostly moderate, but in severely eroded areas it is low. Runoff is rapid or very rapid depending on slope. The plow layer becomes very compact and difficult to work if these soils are cultivated or are trampled by livestock when wet. Maintaining tilth and organic matter are management needs. Erosion is a hazard. Lateral seepage causes wet spots on slopes.

Where slopes are 2 to 12 percent, these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Where slopes are more than 12 percent, the soils are better suited to hay, pasture, or woodland.

Representative profile of Morley silt loam, 2 to 6 percent slopes, eroded, in a cultivated field, 20 feet east and 725 feet south of the center of sec. 14, T. 33 N., R. 11 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; neutral; abrupt smooth boundary.

A2—7 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak thick platy structure parting to moderate medium granular; friable; neutral; clear wavy boundary.

B21t—9 to 12 inches; yellowish brown (10YR 5/4) heavy clay loam; moderate fine angular and subangular blocky structure; firm; dark brown (10YR 3/3) clay films on most faces of peds; thin discontinuous brown (10YR 5/3) silt or very fine sand coatings on peds; few small pebbles; medium acid; clear wavy boundary.

B22t—12 to 17 inches; brown (10YR 4/3) clay; few fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium angular blocky structure; very firm; thick dark brown (10YR 3/3) clay films on most faces of peds; few small pebbles; medium acid; clear smooth boundary.

B23t—17 to 30 inches; brown (10YR 4/3) clay; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very firm; thick dark brown (10YR 3/3) clay films on most faces of peds; few small pebbles; slightly acid; clear smooth boundary.

B3t—30 to 39 inches; brown (10YR 5/3) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to moderate coarse subangular blocky; firm; dark brown (10YR 3/3) clay films on most vertical faces of peds and in linings of vertical cracks; grayish brown (10YR 5/2) lime nodules; few small pebbles; mildly alkaline; gradual wavy boundary.

C—39 to 60 inches; brown (10YR 5/3) clay loam; common fine distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; firm; common fine pebbles; strong effervescence; moderately alkaline.

The solum ranges from 24 to 42 inches in thickness. The A horizon ranges from 8 to 12 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3) unless severely eroded. In cultivated areas, the A2 horizon is mixed with the Ap horizon. The B21t, B22t, and

B23t horizons are heavy silty clay loam, heavy clay loam, silty clay, or clay. They are 35 to 50 percent clay in the finest textured part. Some pedons do not have a B3 horizon. In some pedons the B3 horizon is mottled with grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). Some pedons have no light colored mottles throughout the solum. The C horizon is silty clay loam or clay loam.

Morley soils are associated with Miami and Rawson soils. They contain more clay throughout the solum than Miami soils and more clay in the surface layer and upper part of the subsoil than Rawson soils.

MrB2—Morley silt loam, 2 to 6 percent slopes, eroded. This soil is on long, narrow breaks along drainageways and depressions and on irregularly shaped knolls and ridgetops in the upland. Most areas are 5 to 80 acres in size. Slopes are mostly complex and undulating. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are long, narrow areas of Blount silt loam in drainageways. In some areas west of Albion and in an area of several square miles in northeastern Washington Township, Morley soils are underlain at a depth of 5 to 10 feet by sand and gravelly sand strata. These areas are gently undulating plains with many well drained potholes. The major potholes are identified by spot symbols on the soil map. Areas of ½ acre to 2 acres where the surface layer is sand or loamy sand and severely eroded areas, also ½ acre to 2 acres in size, are identified by spot symbols on the soil map. In places the surface layer is loam. Also included are small areas of Rawson loam.

Erosion is a hazard on this Morley soil. Runoff is rapid.

This soil is suitable for row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Limitations are moderate or severe for most nonfarm uses. Capability unit IIe–6; woodland group 1o1.

MrC2—Morley silt loam, 6 to 12 percent slopes, eroded. This soil occupies the long, narrow breaks along drainageways or depressions and around potholes and the irregularly shaped knolls in the uplands. Slopes are convex and are less than 200 feet long. Most areas are 5 to 80 acres. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are somewhat thinner. The plow layer is a mixture of the original surface layer and the yellowish brown upper part of the subsoil.

Some severely eroded areas of ½ acre to 2 acres, identified by spot symbols on the soil map, have a yellowish brown silty clay loam plow layer. Other areas, particularly those in woods, are not eroded. Spot symbols also identify areas of ½ acre to 2 acres where the surface layer is sand or loamy sand. In some places west of Albion and in an area in southeastern Washington Township, Morley soils are underlain at a depth of 4 to 10 feet by sand and gravelly sand. These areas are undulating plains with many well drained potholes, which are identified by spot symbols on the soil map. Gullies 1 foot to 2 feet or more deep are also identified by spot symbols. Also included are small areas particularly on ridgetops where slopes are 2 to 6 percent. In some areas the surface layer is loam and the upper part of the subsoil is clay loam.

Erosion is a serious hazard. Runoff is rapid. Limitations for most nonfarm uses are moderate or severe.

This soil is suited to row crops occasionally if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Capability unit IIIe–6; woodland group 1o1.

MrD2—Morley silt loam, 12 to 18 percent slopes, eroded. This soil occupies the long, narrow breaks along drainageways and depressions and the irregularly shaped knolls in the upland. Most areas are 3 to 80 acres. Slopes are generally less than 100 feet long. In the areas southwest, south, and southeast of Albion, however, longer slopes are common. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner. The plow layer is a mixture of the original surface layer and the yellowish brown upper part of the subsoil.

Included in mapping are small areas typically on the tops of knolls where slopes are 2 to 12 percent. Some small severely eroded areas of ½ acre to 2 acres, identified by spot symbols on the soil map, have a yellowish brown silty clay loam plow layer. Other areas, particularly those in woods, are not eroded. West of Albion, some areas are underlain by sand and gravelly sand at a depth of 4 to 10 feet. The surface layer is loam in a few places.

Erosion is a serious hazard, and slope is a limitation. Runoff is very rapid. Limitations are severe for most nonfarm uses.

This soil is well suited to hay or pasture and to woodland. Most areas are used for hay and pasture and woodland. Some are used occasionally for corn, soybeans, and small grain. Capability unit IVe–6; woodland group 1o1.

MsC3—Morley silty clay loam, 6 to 12 percent slopes, severely eroded. This soil occupies narrow breaks along drainageways or depressions and irregularly shaped knolls in the uplands. Slopes are generally less than 100 feet long, but in areas south, southwest, and southeast of Albion they are longer. Most areas are 3 to 80 acres in size. The profile of this soil is similar to the one described as representative of the series, but most of the surface layer and, in some places, some of the subsoil have been removed by erosion. Horizons above the substratum are thinner. The plow layer is mainly the yellowish brown silty clay loam subsoil.

Included with this soil in mapping are small, less eroded areas where the surface layer is silt loam. In a few places the calcareous substratum is at the surface. A few gullies 1 foot to 2 feet or more deep are identified by spot symbols on the soil map. Also included are small areas on the top of knolls where slopes are 2 to 6 percent.

Erosion is a serious hazard on this Morley soil. The soil has poor tilth and is difficult to work. It is sticky when wet and hard and cloddy when dry. Productivity is commonly low. Runoff is rapid.

This soil is suited occasionally to row crops if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. The soil is best suited to hay, pasture, or woodland. Limitations are moderate or severe for

most nonfarm uses. Capability unit IVe–6; woodland group 1o1.

MsD3—Morley silty clay loam, 12 to 18 percent slopes, severely eroded. This soil occupies narrow breaks along drainageways and depressions and irregularly shaped knolls in the uplands. Slopes are convex. They are generally less than 100 feet long, but in areas south, southeast, and southwest of Albion they are longer. Most areas are 2 to 60 acres in size. The profile of this soil is similar to the one described as representative of the series, but most of the surface layer and, in places, some of the subsoil have been removed by erosion. Horizons above the substratum are thinner. The plow layer is mainly the yellowish brown silty clay loam subsoil.

Included with this soil in mapping are small areas where the surface layer is silt loam. In a few places the calcareous substratum is at the surface. Gullies 1 foot to 2 feet or more deep are identified by spot symbols on the soil map. Also included are a few, small, uneroded areas that are used for woodland; some areas where slopes are 2 to 12 percent; and small areas, commonly at the tops of knolls, where slopes are 2 to 6 percent.

Erosion is a serious hazard and slope a limitation on this Morley soil. The soil has poor tilth and is difficult to work. It is sticky when wet and hard and cloddy when dry. Productivity is generally low. Runoff is very rapid.

This soil is well suited to meadow, pasture, and woodland. Most areas are used for pasture or hay or are idle, but a few areas are used occasionally for corn, soybeans, and small grain. Limitations are severe for most nonfarm uses. Capability unit VIe–1; woodland group 1o1.

MtE—Morley soils, 18 to 25 percent slopes. This mapping unit occupies narrow breaks along depressions and drainageways and irregularly shaped knolls and ridges in the upland. Slopes are mainly convex. Most areas are 5 to 60 acres in size. These soils have profiles similar to the ones described as representative of the series, but the surface layer and subsoil are thinner. In severely eroded areas, the plow layer is mainly the yellowish brown silty clay loam subsoil. In some uneroded areas, especially in woodland, most of the original surface layer remains. In other areas the plow layer is a mixture of the surface layer and the subsoil.

Included with this unit in mapping are a few small areas of Morley soils, commonly on the top of knolls, where slopes are 3 to 12 percent; several areas where slopes are 25 to 35 percent; and a few areas where slopes are as much as 50 percent. In some places the surface layer is loam. In a few, the calcareous clay loam substratum is at the surface. Gullies 1 foot to 2 feet deep are identified by spot symbols on the soil map.

Erosion is a serious hazard and slope a limitation. Runoff is very rapid. Productivity is commonly low. Maintaining tilth and the supply of organic matter are management needs.

This mapping unit is well suited to pasture and woodland. Most areas are used for pasture or woodland or are idle. Limitations are severe for most nonfarm uses. Capability unit VIe–1; woodland group 1r2.

MuC2—Morley, Miami, and Rawson loams, 6 to 12 percent slopes, eroded. This mapping unit is on undulating, glacial till planes. It is on irregularly shaped knolls and on narrow breaks along drainageways and depressions in the upland. The unit is between broad areas of soils that formed mainly in medium textured glacial till and those that formed in moderately fine textured glacial till.

Of the total acreage of this mapping unit, about 40 percent is Morley loam, 30 percent is Miami loam, 20 percent is Rawson loam, and 10 percent is soils of minor extent. These soils occur in complex patterns, and any mapped area can contain one or two or all three soils. The Morley, Miami, and Rawson soils have profiles similar to the ones described as representative of their respective series, but the surface layer of Morley soils is mainly loam.

Included with this unit in mapping are small areas of Morley soils where the surface layer is silt loam. Severely eroded areas ½ acre to 2 acres in size where the surface layer is clay loam or silty clay loam are identified by spot symbols on the soil map.

Erosion is a hazard. Runoff is rapid. Maintaining tilth and the supply of organic matter are management needs.

This mapping unit is suited to occasional row crops if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Limitations are moderate or severe for most nonfarm uses. Capability unit IIIe–6; woodland group 1o1.

Oshtemo Series

The Oshtemo series consists of deep, well drained, moderately coarse textured or coarse textured soils. These soils formed in moderately coarse textured glacial outwash. They occupy the broad flats or breaks around potholes and along drainageways or depressions on outwash plains or the knolls in the upland. They are nearly level to moderately sloping. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 10 inches of dark brown loamy sand. The subsurface layer is 8 inches of brown loamy sand. The subsoil is about 35 inches thick. In sequence from the top, it is 5 inches of very friable, dark brown sandy loam; 3 inches of friable, dark brown light sandy clay loam; and 27 inches of very friable, yellowish brown loamy sand that has 8 inches of dark brown sandy loam in ½- to 1½-inch strata. The substratum to a depth of about 60 inches is brown, stratified sand and gravelly sand.

Permeability is moderately rapid, and the available water capacity is moderate. The content of organic matter is moderate or low. Droughtiness is a limitation. Erosion is a hazard on sloping soils. Maintaining the supply of organic matter is a management need.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Because of droughtiness, crops that mature early in the season are better suited than other crops.

Representative profile of Oshtemo loamy sand, 2 to 6 percent slopes, in a cultivated field, 100 feet east

and 2,240 feet south of the center of sec. 33, T. 35 N., R. 9 E.

Ap—0 to 10 inches; dark brown (10YR 4/3) loamy sand; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A2—10 to 18 inches; brown (10YR 4/3) loamy sand; weak medium granular structure; very friable; common fine tubular pores; slightly acid; clear smooth boundary.

B21t—18 to 23 inches; dark brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; very friable; few patchy distinct thin dark reddish brown (5YR 3/2) clay films on peds and bridges between sand grains; 5 percent fine gravel; medium acid; clear wavy boundary.

B22t—23 to 26 inches; dark brown (7.5YR 4/4) light sandy clay loam; weak medium subangular blocky structure; friable; common discontinuous distinct thin dark brown (7.5YR 3/2) clay films on peds and in voids; 10 percent fine gravel; strongly acid; clear wavy boundary.

B3—26 to 53 inches; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; 8 inches of dark brown (7.5YR 4/4) sandy loam strata, ½ inch to 1½ inches thick, and common discontinuous distinct thin dark brown (7.5YR 3/2) clay films on peds and in voids; about 5 percent fine gravel; strongly acid grading to neutral in lower part; abrupt irregular boundary.

IIC—53 to 60 inches; brown (10YR 5/3) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3) sandy loam or loamy sand. Some pedons have a B1 horizon of brown (10YR 5/3 or 4/3) or yellowish brown (10YR 5/4) sandy loam or loamy sand. The Bt horizon is as much as 6 inches of light sandy clay loam or light clay loam in some pedons. The B2 horizon is sandy loam or is loamy sand and strata of sandy loam or light sandy clay loam.

Oshtemo soils are associated with Fox and Boyer soils. They contain less clay in the subsoil than Fox soils. Their subsoil extends to a greater depth than that of Boyer or Fox soils.

OsB—Oshtemo loamy sand, 2 to 6 percent slopes. This soil occupies irregularly shaped knolls and ridgetops in the upland and narrow breaks along drainageways and around potholes on outwash plains. Most areas are 5 to 100 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small nearly level areas on narrow ridgetops, areas along drainageways and around potholes where slopes are 6 to 12 percent, and small areas of Boyer loamy sand. Areas ½ acre to 2 acres in size where gravel on the surface interferes with tillage and potholes, also ½ acre to 2 acres in size, are identified by spot symbols on the soil map. The potholes have eroded side slopes, and 2 to 3 feet of dark brown sandy loam is in the lower part. The surface layer and subsurface layer are sandy loam in some areas.

Soil blowing and erosion are hazards and droughtiness a limitation on this Oshtemo soil. This soil absorbs water readily and is easy to work. The content of organic matter is low. Runoff is slow.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Irrigated areas are well suited to these crops. Limitations are slight for most nonfarm uses. Capability unit IIIs–2; woodland group 3s17.

OsC—Oshtemo loamy sand, 6 to 12 percent slopes. This soil occupies the breaks along drainageways and around potholes on outwash plains or the irregularly shaped knolls in the upland. Most areas are 3 to 30 acres in size. Slopes are generally less than 200 feet long. The profile of this soil is similar to the one described as representative of the series, but the surface layer is somewhat lighter in color.

Included with this soil in mapping are areas where the surface layer and subsurface layer are sandy loam, small areas of Boyer loamy sand, and small gently sloping or nearly level areas on the top of knolls. Steep or very steep, narrow breaks or bluffs are identified by spot symbols on the soil map. In some areas erosion has removed 3 to 5 inches of the surface layer. In these areas the surface layer is lighter in color and is a mixture of topsoil and the brown upper part of the subsoil.

Droughtiness is a limitation and erosion and soil blowing are hazards on this Oshtemo soil. The soil absorbs water readily and is easy to work. The content of organic matter is low. Runoff is medium. Slope limits irrigation.

Most areas of this soil are used for corn, soybeans, and small grain or for grasses and legumes for hay and pasture. Limitations are moderate for most nonfarm uses. Capability unit IIIe–13; woodland group 3s17.

OtA—Oshtemo sandy loam, 0 to 2 percent slopes. This nearly level soil is in irregularly shaped, large areas between drainageways and depressions on broad, slightly undulating outwash plains. Most areas are 20 to 200 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsurface layer are sandy loam and the subsoil contains somewhat more clay.

Included with this soil in mapping are some areas on low rises where slopes are 1 to 2 percent and the surface layer and subsurface layer are loamy sand. Potholes ½ acre to 2 acres in size where slopes are 2 to 6 percent and areas, also ½ acre to 2 acres in size, where considerable gravel is on the surface are identified by spot symbols on the soil map. In some broad, nearly level areas north of Cromwell, the surface layer is very dark grayish brown. Also included are areas of a similar moderately well drained soil and nearly level areas of Boyer loamy sand.

Droughtiness is a limitation on this Oshtemo soil. The soil absorbs water readily and is easy to work. The content of organic matter is moderate.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Irrigated areas are well suited to these crops. Limitations are slight for most nonfarm uses. Capability unit IIIs–2; woodland group 3s17.

Palms Series

The Palms series consists of deep, very poorly drained organic soils. These nearly level soils are in depressional areas in the upland and on outwash plains and bottom land. The depressions were formerly ponded areas in which plant remains accumulated over a long period. The soils formed in partly decomposed organic material over moderately coarse textured to

moderately fine textured mineral material. The native vegetation was cattails, sedges, and water-tolerant trees, shrubs, and grasses.

In a representative profile the surface layer is 13 inches of black muck. The next layer is 14 inches of very friable, dark reddish brown muck and a few dark brown herbaceous fibers. The upper 5 inches of the substratum is dark gray silty clay loam mottled with yellowish brown. The lower part to a depth of about 60 inches is grayish brown, stratified sandy loam, loam, and clay loam mottled with yellowish brown.

Permeability is rapid in the organic material and moderate in the substratum. The available water capacity is very high. The content of organic matter is very high. Runoff is very slow. Some areas are ponded. These soils are subject to subsidence when drained. Wetness is a serious limitation. The seasonal high water table is at or near the surface. Soil blowing is a hazard. Trafficability and load-supporting capacity are poor.

These soils are suited to corn, soybeans, grasses and legumes, sweet corn, mint, onions, and potatoes.

Representative profile of Palms muck, drained, in a cultivated field, 125 feet east and 1,840 feet south of the center of sec. 19, T. 33 N., R. 9 E.

Oap—0 to 9 inches; black (10YR 2/1) rubbed sapric material; less than 5 percent fiber; a trace of fiber rubbed; moderate fine and very fine granular structure; very friable; 20 percent mineral content; neutral; abrupt smooth boundary.

Oa2—9 to 13 inches; black (10YR 2/1) rubbed sapric material; less than 5 percent fiber; a trace of fiber rubbed; moderate fine granular structure; very friable; 20 percent mineral content; neutral; clear smooth boundary.

Oa3—13 to 27 inches; dark reddish brown (5YR 2/2) rubbed sapric material; about 15 percent fiber; less than 5 percent fiber rubbed; moderate fine granular structure; very friable; 10 percent mineral content; few dark brown (7.5YR 3/2) rubbed herbaceous fibers; neutral; abrupt smooth boundary.

IIC1g—27 to 32 inches; dark gray (5Y 4/1) silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; few shell fragments and a thin strata of light gray (10YR 7/1) marl; calcareous; clear smooth boundary.

IIC2g—32 to 60 inches; grayish brown (10YR 5/2) stratified sandy loam, loam, and clay loam; many fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; strong effervescence; moderately alkaline.

The sapric horizons range from 16 to 40 inches in thickness and from medium acid to neutral in reaction. The Oa2 and Oa3 horizons are black (10YR 2/1), very dark brown (10YR 2/2), or dark reddish brown (5YR 2/2), depending on decomposition of the organic material. In some pedons few woody fragments consisting of partly decomposed logs and branches are in the Oa2 and Oa3 horizons, and in some pedons thin strata of mineral material are in the Oa3 horizon. The IIC horizon is sandy loam, loam, silt loam, clay loam, or silty clay loam.

Palms soils are similar to Houghton and Adrian soils. Palms soils are underlain, at a depth of 16 to 40 inches, by finer textured mineral material than Adrian soils. Houghton soils, in contrast, are organic to a depth of 40 inches.

Pb—Palms muck, drained. This nearly level soil is in drained depressional areas where the water table is 2 feet or more below the surface most of the year. Slopes are 0 to 2 percent. Areas are irregular in shape. Most are 2 to 20 acres in size.

Included with this soil in mapping are small areas of Houghton muck. A thin layer of marl is in the upper part of the mineral substratum in some areas. In places the substratum is silty clay or clay. Around the edge of many areas are narrow strips where the muck is only 12 to 16 inches deep over the mineral material. Small undrained areas ½ acre to 2 acres in size and areas where considerable reddish brown or yellowish red iron-oxide concretions or nodules are on the surface are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Palms soil. Drainage has caused subsidence of the muck, and soil blowing is a hazard when the soil is dry. Fire is a hazard because muck readily burns when dry.

Row crops are suited each year. Most areas are used for corn, soybeans, and pasture. They are also suited to many vegetable crops. Limitations are severe for most nonfarm uses. Capability unit IIw–10; woodland group 4w23.

Parr Series

The Parr series consists of deep, well drained, medium textured soils. These soils formed under grasses and hardwood trees in medium textured glacial till in the upland. They are nearly level.

In a representative profile the surface layer is 12 inches of very dark grayish brown loam. The subsoil is about 30 inches thick. In sequence from the top, it is 5 inches of firm, dark yellowish brown light clay loam; 12 inches of firm, dark yellowish brown clay loam; 7 inches of firm, yellowish brown clay loam; and 6 inches of friable, brown heavy loam. The upper part of the substratum is about 48 inches of pale brown loam, and the lower part is about 20 inches of yellowish brown, stratified sand and gravelly sand.

Permeability is moderate, and the available water capacity is high. The content of organic matter is high. Runoff is slow. The soils have no limitations that affect their use for crops. Maintaining tilth and the supply of organic matter are management needs.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Tomatoes and sweet corn are also well suited.

Representative profile of Parr loam, 0 to 2 percent slopes, in a cultivated field, 100 feet east and 2,540 feet north of the southwest corner of sec. 12, T. 35 N., R. 8 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 12 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; friable; neutral; clear smooth boundary.

B1—12 to 17 inches; dark yellowish brown (10YR 4/4) light clay loam; moderate fine subangular blocky structure; firm; few fine pebbles; slightly acid; clear wavy boundary.

B21t—17 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; few fine pebbles; dark brown (10YR 3/3) clay films on faces of most peds and lining of voids; medium acid; clear smooth boundary.

B22t—29 to 36 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few fine pebbles; dark yellowish brown (10YR 3/4) clay films on faces of some peds; medium acid grading to neutral in lower part; clear wavy boundary.

B3t—36 to 42 inches; brown (10YR 5/3) heavy loam; weak coarse subangular blocky structure; friable; many fine

pebbles; dark yellowish brown (10YR 3/4) clay films on cleavage faces and in vertical cracks; strong effervescence; moderately alkaline; gradual wavy boundary.
C—42 to 90 inches; pale brown (10YR 6/3) loam; massive; friable; common fine pebbles; strong effervescence; moderately alkaline; abrupt irregular boundary.
IIC—90 to 110 inches; yellowish brown (10YR 5/4) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 30 to 42 inches in thickness. The Ap and A12 horizons are very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2) and are 10 to 15 inches thick. The B21t and B22t horizons contain some strata of silty clay loam or sandy clay loam and are dark brown (7.5YR 4/4) in some pedons. The B21t and B22t horizons are medium acid or slightly acid. Some pedons do not have a B3t horizon.

Parr soils are associated with Warsaw and Miami soils. They are finer textured in the subsoil and the upper part of the substratum than Warsaw soils and have a darker surface layer than Miami soils.

PdA—Parr loam, 0 to 2 percent slopes. This soil is on broad flats and in long, narrow, closed slightly depressional areas in the upland. Most areas are 3 to 20 acres in size.

Included with this soil in mapping are areas where the surface layer is 15 to 18 inches thick. In some places depth of the substratum is 42 to 55 inches. Also included are a few small areas of Miami loam, gravelly substratum. The depth of sand and gravelly sand is dominantly 4 to 8 feet, but in some areas it is as much as 10 feet.

This Parr soil has no limitations that affect its use for commonly grown crops.

This soil is suited to row crops year after year. Most areas are used for corn and soybeans and are also suited to small grain or to grasses and legumes for hay or pasture. Limitations are slight or moderate for most nonfarm uses. Capability unit I–1; woodland group not assigned.

Pewamo Series

The Pewamo series consists of deep, very poorly drained, moderately fine textured soils. These soils formed in moderately fine textured glacial till. They occupy flats and depressions or drainageways in the upland. They are nearly level. The native vegetation was water-tolerant hardwood trees.

In a representative profile the surface layer is 14 inches of very dark gray silty clay loam. The subsoil is about 34 inches thick. In sequence from the top, it is 13 inches of very firm, dark gray heavy silty clay loam mottled with yellowish brown; 9 inches of very firm, gray silty clay mottled with yellowish brown; and 12 inches of firm, gray heavy silty clay loam mottled with yellowish brown. The substratum to a depth of about 60 inches is grayish brown silty clay loam mottled with yellowish brown and pale brown.

Permeability is moderately slow, and the available water capacity is high. The content of organic matter is high. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture and woodland.

Representative profile of Pewamo silty clay loam, in a cultivated field, 2,300 feet south and 75 feet west of the northeast corner of sec. 1, T. 33 N., R. 11 E.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; neutral; abrupt smooth boundary.
A12—10 to 14 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; firm; neutral; clear smooth boundary.
B21tg—14 to 21 inches; dark gray (10YR 4/1) heavy silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; few fine pebbles; patchy thin very dark gray (10YR 3/1) clay films on some faces of peds; neutral; gradual wavy boundary.
B22tg—21 to 27 inches; dark gray (10YR 4/1) heavy silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; very firm; few fine pebbles; very dark grayish brown (10YR 3/2) clay films on most faces of peds; neutral; gradual wavy boundary.
B23tg—27 to 36 inches; gray (5Y 5/1) silty clay; many fine prominent yellowish brown (10YR 5/6) mottles; moderate medium and coarse angular blocky structure; very firm; few fine pebbles; very dark grayish brown (10YR 3/2) clay films on most faces of peds; neutral; gradual wavy boundary.
B24tg—36 to 48 inches; gray (5Y 5/1) heavy silty clay loam; many fine prominent yellowish brown (10YR 5/6) mottles; moderate coarse angular blocky structure; firm; few fine pebbles; thin dark gray (10YR 4/1) clay films on most vertical faces and on a few horizontal faces of peds; neutral; clear wavy boundary.
C—48 to 60 inches; grayish brown (10YR 5/2) silty clay loam; many fine prominent yellowish brown (10YR 5/4 and 5/6) mottles; many fine distinct pale brown (10YR 6/3) mottles; massive; firm; few fine pebbles; strong effervescence; moderately alkaline.

The solum ranges from 36 to 50 inches in thickness. The Ap and A12 horizons are very dark gray (10YR 3/1), very dark brown (10YR 2/2), black (10YR 2/1), or very dark grayish brown (10YR 3/2) and range from 10 to 14 inches in thickness. The B21tg, B22tg, and B23tg horizons are heavy clay loam, heavy silty clay loam, or silty clay and lesser layers of clay. These horizons are mottled with gray (5Y 5/1 or 10YR 5/1) or dark gray (10YR 4/1). The C horizon is clay loam or silty clay loam.

Pewamo soils are similar to Brookston and Toledo soils. They are finer textured than Brookston soils and are coarser textured in parts of the subsoil and in the substratum than Toledo soils.

Pe—Pewamo silty clay loam. This soil is on broad flats and in shallow, narrow, meandering drainageways and depressions in the upland. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 10 to 100 acres in size.

Included with this soil in mapping are small areas of Blount silt loam on low rises and adjacent flats. Small areas of poorly drained Milford silty clay loam occupy the deeper parts of some depressional areas. In some places the surface layer is silt loam. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. Also included are small areas of Washtenaw silt loam at the base of adjacent eroded slopes. Some areas in drainageways have slopes of 2 to 3 percent.

Wetness is a serious limitation on this Pewamo soil, and drainage is needed. Erosion is a hazard along narrow drainageways during periods of heavy rainfall. The soil becomes hard and cloddy if worked when wet. Maintaining tilth is a management need.

This soil is suited to row crops year after year. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Undrained areas provide habitat for wildlife or are used for woodland or pasture. Limitations are severe for most nonfarm uses. Capability unit IIw–1; woodland group 2w11.

Rawson Series

The Rawson series consists of deep, well drained and moderately well drained, medium textured and moderately coarse textured soils. These nearly level to moderately sloping soils are on knolls in the upland and on outwash plains. They formed in medium textured or moderately coarse textured glacial drift and in the underlying fine textured or moderately fine textured glacial till or sediment. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 8 inches of dark grayish brown loam. The subsurface layer is 2 inches of grayish brown loam. The subsoil is about 30 inches thick. In sequence from the top, it is 4 inches of friable, brown heavy loam; 8 inches of firm, yellowish brown clay loam; 10 inches of firm, dark yellowish brown clay loam mottled with yellowish brown; and 8 inches of very firm, dark yellowish brown clay mottled with yellowish brown. The substratum to a depth of about 60 inches is brown clay loam mottled with yellowish brown and light brownish gray.

Permeability is moderate in the upper part and slow or very slow in the lower part. The available water capacity is high. The content of organic matter is moderate. Runoff is slow to rapid depending on slope. Erosion is a hazard in sloping areas. Lateral seepage causes wet spots near the base of slopes. Maintaining the supply of organic matter is a management need.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture.

Representative profile of Rawson loam, 2 to 6 percent slopes, in a cultivated field, 100 feet east and 125 feet south of the center of sec. 4, T. 34 N., R. 11 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; light brownish gray (10YR 6/2) dry; moderate fine and medium granular structure; friable; slightly acid; abrupt smooth boundary.

A2—8 to 10 inches; grayish brown (10YR 5/2) loam; weak very fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B1—10 to 14 inches; brown (10YR 5/3) heavy loam; weak fine subangular blocky structure; friable; few fine pebbles; medium acid; clear wavy boundary.

B21t—14 to 22 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few fine pebbles; thin dark yellowish brown (10YR 4/4) clay films on most faces of peds; medium acid; gradual wavy boundary.

B22t—22 to 32 inches; dark yellowish brown (10YR 4/4) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine pebbles; thin dark brown (10YR 3/3) clay films on most faces of peds; slightly acid; clear wavy boundary.

IIB23t—32 to 40 inches; dark yellowish brown (10YR 4/4) clay; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; very firm; few fine pebbles; dark brown (7.5YR 4/4) clay films on most vertical faces of peds; slightly acid grading to neutral in the lower part; gradual wavy boundary.

IIC—40 to 60 inches; brown (10YR 5/3) clay loam; few fine distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; firm; few fine pebbles; strong effervescence; moderately alkaline.

The solum ranges from 30 to 42 inches in thickness. The Ap horizon is dark brown (10YR 4/3), dark grayish brown (10YR 4/2), or brown (10YR 5/3) loam or sandy loam. In some pedons the A2 horizon has been mixed with the Ap horizon by cultivation. Some pedons do not have a B1 horizon. The B21t and B22t horizons are dark brown (10YR 4/3 or 7.5YR 4/4) dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4) heavy loam, sandy clay loam, or clay loam. The IIB23t horizon is dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or pale brown (10YR 6/3) silty clay to clay. In some pedons the B22t and IIB23t horizons are mottled with grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). The IIC horizon is clay, clay loam, or silty clay loam. It is moderately fine textured glacial till or fine textured to moderately fine textured sediment.

Rawson soils are associated with Morley and Miami soils. They contain less clay in the surface layer and upper part of the subsoil than Morley soils and more clay in the lower part of the subsoil and in the substratum than Miami soils.

RaB—Rawson sandy loam, 2 to 6 percent slopes. This gently undulating soil occupies narrow breaks along drainageways and irregularly shaped knolls of the upland and outwash plains. Most areas are 3 to 20 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is sandy loam and the upper part of the subsoil is sandy clay loam.

Included with this soil in mapping are areas where erosion has removed 3 to 5 inches of the surface layer and the plow layer is a mixture of the original surface layer and the brown upper part of the subsoil. In a few small areas the surface layer is loam. In some spots the surface layer is loam and the subsoil is silty clay or clay. Also included are small areas of Haskins loam in narrow drainageways. In some areas a few pebbles and small stones are on the surface and are mixed throughout the profile. Near Bakerstown and north of Big Lake there are several areas 3 to 20 acres in size where the upper part of the subsoil is sandy loam. The gently sloping soils in these areas are on irregularly shaped, low rises. They are somewhat droughty, especially for shallow-rooted crops, and yields are lower during prolonged periods of low rainfall.

Erosion is a hazard on this Rawson soil. Runoff is medium. Lateral seepage causes wet spots near the base of slopes.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Limitations are moderate or severe for most nonfarm uses. Capability unit IIe–5; woodland group 1o1.

RaC2—Rawson sandy loam, 6 to 12 percent slopes, eroded. This soil occupies narrow breaks along drainageways and irregularly shaped knolls in the upland. Slopes are generally about 50 to 100 feet long. Most areas are 2 to 10 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is sandy loam and the upper part of the subsoil is sandy clay loam. Also, 3 to 6 inches of the surface layer has been removed by erosion, and the plow layer is grayish brown.

Included with this soil in mapping are some small areas where the surface layer is loam and the subsoil is silty clay or clay. Some small areas, especially in woodland, are not eroded. In some areas the surface layer is loam and the upper part of the subsoil is clay loam. In others, a few pebbles and small stones are on the surface and are mixed throughout the profile. Severely eroded areas ½ acre to 2 acres in size are identified by spot symbols on the soil map.

Erosion is a hazard on this Rawson soil. Runoff is rapid. Lateral seepage causes wet spots near the base of slopes.

This soil is suited occasionally to row crops if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Some areas are used for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIIe–5; woodland group 1o1.

RbA—Rawson loam, 0 to 2 percent slopes. This gently undulating soil occupies irregularly shaped areas on ridgetops and knolls of the upland and outwash plains. On the plains, slopes are dominantly 1 to 2 percent. Most areas are 2 to 10 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsurface layer are somewhat thicker.

Included with this soil in mapping are some long, narrow areas of Haskins loam in shallow drainageways and small areas of Morley silt loam. Areas ½ acre to 2 acres in size where the surface layer is sand or loamy sand are identified by spot symbols on the soil map. In places a few pebbles and small stones are on the surface and are mixed throughout the profile. In a few areas near Bakerstown and north of Big Lake, the surface layer is sandy loam and the upper part of the subsoil is heavy sandy loam and sandy clay loam.

This Rawson soil has no limitations or hazards that affect use for crops. Runoff is slow.

This soil is suited to row crops each year. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Limitations are moderate or severe for most nonfarm uses. Capability unit I–1; woodland group 1o1.

RbB—Rawson loam, 2 to 6 percent slopes. This gently undulating soil occupies narrow breaks along drainageways and irregularly shaped knolls in the upland and on outwash plains. Most areas are 3 to 20 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are long, narrow areas of Haskins loam in drainageways and small areas of Morley loam. Erosion has removed about 3 to 5 inches of the surface layer in some places, and the plow layer is a mixture of the original surface layer and the brown upper part of the subsoil. In some areas west of Albion, the soil is underlain at a depth of 5 to 10 feet by sand and gravelly sand. In places a few pebbles and cobblestones are on the surface and are mixed throughout the profile.

Erosion is a hazard on this Rawson soil. Runoff is medium. Lateral seepage causes wet spots near the base of some slopes.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain or for grasses and legumes for hay or pasture. Limitations are moderate or severe for most nonfarm uses. Capability unit IIe–1; woodland group 1o1.

RdB2—Rawson, Morley, and Miami loams, 2 to 6 percent slopes, eroded. This undulating or gently sloping mapping unit is on irregularly shaped knolls and ridgetops on glacial till plains of the upland. It occupies areas between soils that formed mainly in medium textured glacial till and those formed in moderately fine textured glacial till.

Of the total acreage of this mapping unit, about 40 percent is Rawson loam, 20 percent is Morley loam, 20 percent is Miami loam, and 20 percent is soils of minor extent. These soils are in a complex pattern, and any mapped area can contain one or two or all three soils. The Miami, Morley, and Rawson soils have profiles similar to the ones described as representative of their respective series, but the surface layer of Morley soils is loam.

Included with this unit in mapping are a few areas of Morley silt loam and small areas of Crosier loam and Haskins loam in drainageways. Severely eroded areas ½ acre to 2 acres in size are identified by spot symbols on the soil map. Some areas, especially in woodland, are not eroded. In many areas pebbles and a few small stones are on the surface and are mixed throughout the profile.

Erosion is a hazard. Runoff is rapid. Maintaining tilth and the supply of organic matter are management needs.

This mapping unit is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and small grain and for grasses and legumes for hay and pasture. Limitations are slight to severe for most nonfarm uses. Capability unit IIe–1; woodland group 1o1.

Rensselaer Series

The Rensselaer series consists of deep, very poorly drained, medium textured soils. These nearly level soils occupy depressions in the upland or outwash plains. They formed in medium textured and moderately coarse textured sediment in glacial drainageways. The native vegetation was water-tolerant hardwood trees.

In a representative profile the surface layer is 13 inches of very dark grayish brown loam and very dark gray heavy loam. The subsoil is about 29 inches thick. In sequence from the top, it is 5 inches of friable, gray heavy loam mottled with yellowish brown; 7 inches of firm, gray clay loam mottled with strong brown and dark yellowish brown; 13 inches of firm, gray clay loam mottled with strong brown and brown; and 4 inches of very friable, gray heavy sandy loam mottled with brown and yellowish brown. The substratum to a depth of about 60 inches is light brownish gray, stratified fine sand, silt, and sandy loam mottled with olive yellow and yellowish brown.

Permeability is slow, and the available water capacity is high. The content of organic matter is high. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Rensselaer loam in a cultivated field, 2,440 feet south and 50 feet west of the northeast corner of sec. 33, T. 35 N., R. 10 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark gray (10YR 3/1) heavy loam, grayish brown (10YR 5/2) dry; moderate medium granular structure; friable; neutral; clear smooth boundary.

B21tg—13 to 18 inches; gray (5Y 5/1) heavy loam; common fine prominent yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; common discontinuous distinct dark gray (5Y 4/1) clay films on faces of peds and in linings of voids; neutral; clear wavy boundary.

B22tg—18 to 25 inches; gray (5Y 5/1) clay loam; common fine prominent strong brown (7.5YR 5/6) mottles and few fine prominent dark yellowish brown (10YR 4/4) mottles; moderate fine and medium subangular blocky structure; firm; many continuous prominent dark gray (5Y 4/1) clay films on most faces of peds and in linings of voids; neutral; gradual wavy boundary.

B23tg—25 to 38 inches; gray (5Y 5/1) clay loam; many fine prominent strong brown (7.5YR 5/6) mottles and few fine prominent brown (7.5YR 4/4) mottles; moderate coarse subangular blocky structure; firm; common discontinuous distinct dark gray (5Y 4/1) clay films on peds and in linings of voids; few black (10YR 2/1) iron- and manganese-oxide concretions; neutral; very wavy boundary.

IIB3g—38 to 42 inches; gray (5Y 5/1) heavy sandy loam; common fine prominent brown (7.5YR 4/4) and yellowish brown (10YR 5/4) mottles; weak coarse subangular blocky structure; very friable; neutral; clear wavy boundary.

IIC—42 to 60 inches; light brownish gray (2.5Y 6/2) stratified fine sand, silt, and sandy loam; many fine prominent olive yellow (2.5Y 6/8) mottles and few fine prominent yellowish brown (10YR 5/6) mottles; massive; very friable; strong effervescence; moderately alkaline.

The solum ranges from 36 to 48 inches in thickness. The A horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1) and is 10 to 18 inches thick. Some pedons have a B1g horizon. The B22tg and B23tg horizons are gray (5Y 5/1) or dark gray (5Y 4/1). Some pedons do not have a IIB3g horizon. Part of the B2 horizon is silty clay loam, sandy clay loam, or loam in some pedons. The C horizon is stratified silt, fine sand, silt loam, and loam and minor strata of light clay loam and sandy loam.

Rensselaer soils are similar to and commonly associated with Brookston and Sebewa soils. They typically are coarser textured and are more stratified in the substratum than Brookston soils and contain fewer pebbles and a lesser amount of coarse sand in the subsoil and in the substratum than Sebewa soils.

Re—Rensselaer loam. This soil occupies broad depressional areas of the upland and outwash plains. Slopes are 0 to 2 percent. Most areas are irregular in shape and are 10 to 60 acres in size.

Included with this soil in mapping are small areas of Whitaker loam on low rises and adjacent flats. In a few long strips at the edge of broad depressional areas, the surface layer is fine sandy loam. In some areas the surface layer is silt loam. In some, the subsoil is as much as 5 percent gravel. In a few, the upper part of the subsoil is silty clay. The surface layer is mucky loam in the lowest part of some depressions. Along Little Cedar Creek this soil is underlain by sand and gravelly sand below a depth of 60 inches. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops and areas 1 acre to 5 acres in size where the surface layer is limy, sandy or loamy material are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Rensselaer soil. Drainage is needed.

This soil is suited to row crops each year. Most areas are used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. A few areas are used for woodland. Limitations are severe for most nonfarm uses. Capability unit IIw–1; woodland group 2w11.

Riddles Series

The Riddles series consists of deep, well drained, moderately coarse textured soils. These nearly level to strongly sloping soils occupy flats and knolls or breaks along drainageways and depressions in the upland. They formed in medium textured glacial drift and in the underlying medium textured glacial till. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is about 9 inches of dark grayish brown sandy loam. The subsurface layer is about 5 inches of brown heavy sandy loam. The subsoil is about 8 inches thick. The upper 33 inches is firm, dark yellowish brown clay loam, and the lower 5 inches is friable, dark yellowish brown sandy clay loam. The substratum to a depth of about 72 inches is yellowish brown loam.

Permeability is moderate, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow to very rapid, depending on slope. Erosion is a hazard on sloping soils. Maintaining the supply of organic matter is a management need.

Where slopes are 0 to 12 percent, these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Where slopes are more than 12 percent, they are better suited to hay, pasture, or woodland.

Representative profile of Riddles sandy loam, 2 to 6 percent slopes, in a cultivated field, 1,300 feet east and 225 feet south of the northwest corner of sec. 16, T. 35 N., R. 9 E.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) sandy loam; moderate fine granular structure; friable; common pebbles and few small stones; slightly acid; abrupt smooth boundary.

A2—9 to 14 inches; brown (10YR 5/3) heavy sandy loam; weak medium platy structure parting to moderate fine granular; friable; many voids filled with dark grayish brown (10YR 4/2) sandy loam; common pebbles and a few small stones; many clean sand grains on faces of peds; many tubular pores; slightly acid; clear wavy boundary.

B21t—14 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; common pebbles and few small stones; common discontinuous distinct thin brown (7.5YR 4/4) clay films on faces of peds; common tubular pores; few clean sand grains on faces of peds; medium acid; clear wavy boundary.

B22t—20 to 34 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; common pebbles and few small stones; many continuous distinct medium brown (7.5YR 4/4) clay films on faces of peds; medium acid; gradual wavy boundary.

B23t—34 to 47 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common pebbles and few small stones; many continuous distinct thin brown (7.5YR 4/4) clay films on faces of peds; medium acid; gradual wavy boundary.

B24t—47 to 52 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak medium and coarse subangular blocky structure; friable; common pebbles and few small stones; many continuous distinct thin brown (7.5YR 4/4) clay films on most vertical and some horizontal faces of peds; slightly acid grading to neutral in lower part; clear wavy boundary.

C—52 to 72 inches; yellowish brown (10YR 5/4) loam; massive; friable; common pebbles and few small stones; strong effervescence; moderately alkaline.

The solum ranges from 42 to 64 inches in thickness. The content of gravel ranges from 2 to 10 percent. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). In some pedons the A2 horizon has been mixed with the Ap horizon by cultivation. Some pedons have a B1 horizon of brown (10YR 5/3) or yellowish brown (10YR 5/4) loam or light clay loam. The B2t horizon is dominantly clay loam and lesser layers of sandy clay loam and loam. Some pedons have a B3 horizon of brown (10YR 5/3), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4) loam or light clay loam. The C horizon is loam or light clay loam. Some pedons have thin strata or pockets of sand or sand and gravelly sand in the B24t, B3, and C horizons.

Riddles soils are associated with Miami and Metea soils. They have a deeper solum than Miami soils and are finer textured in the A horizon and in the upper part of the B horizon than Metea soils.

RsA—Riddles sandy loam, 0 to 2 percent slopes. This soil occupies irregularly shaped areas on knolls and ridgetops in the upland. Most areas are slightly undulating, and slopes are mostly 1 to 2 percent. Most areas are 5 to 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is 2 to 3 inches thicker.

Included with this soil in mapping are small areas of Crosier loam in narrow drainageways. In some areas the surface and subsurface layers are loam. Gravel and a few small stones are common on the surface and are mixed throughout the profile. In places pockets and strata of sand and gravel are between the subsoil and loam substratum. Also included are a few areas where the depth to the loamy substratum ranges from 24 to 42 inches.

Droughtiness is a limitation for shallow-rooted crops during prolonged periods of low rainfall. Runoff is slow. The content of organic matter is moderate.

This soil is suited to row crops every year. Most areas are used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. Limitations are slight or moderate for most nonfarm uses. Capability unit I–3; woodland group 1o1.

RsB—Riddles sandy loam, 2 to 6 percent slopes. This soil occupies irregularly shaped knolls and narrow breaks along drainageways and depressions in the upland. Slopes are mostly convex and undulating and are less than 250 feet long. Most areas are 5 to 100 acres in size. The profile of this soil is the one described as representative of the series.

Included with this soil in mapping are small areas of Crosier loam in narrow drainageways. In a few areas erosion has removed about 3 to 5 inches of the surface layer and the plow layer is a mixture of the surface layer and the brown upper part of the subsoil. In some areas the surface and subsurface layers are loam. Also included are a few areas where the depth to the loamy substratum ranges from 24 to 42 inches. Areas ¼ acre to 2 acres in size where stones at or near the surface seriously interfere with tillage are identified by spot symbols on the soil map. Gravel and a few small stones are common on the surface and are mixed throughout the profile.

Erosion is a hazard on this Riddles soil. Droughtiness is a limitation for shallow-rooted crops during prolonged periods of low rainfall. The content of organic matter is moderate.

This soil is suited to row crops most of the time if erosion is controlled. Most areas are used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. A few areas are used for woodland. Limitations are slight or moderate for most nonfarm uses. Capability unit IIe–5; woodland group 1o1.

RsC2—Riddles sandy loam, 6 to 12 percent slopes, eroded. This soil occupies irregularly shaped knolls and narrow breaks along drainageways and depressions in the upland. Slopes are generally less than 200 feet long. Most areas are 5 to 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thinner and lighter in color and the subsoil is thinner.

Included with this soil in mapping are some uneroded areas, especially in woodland, where nearly all the surface layer remains and small areas on the top of knolls where slopes are 2 to 6 percent. In some areas the surface and subsurface layers are loam. Also included are a few areas where the depth to the loamy substratum ranges from 24 to 42 inches. Areas ¼ acre to 2 acres in size where stones at or near the surface seriously interfere with tillage are identified by spot symbols on the soil map. Gravel and a few cobblestones are common on the surface and are mixed throughout the profile.

Erosion is a hazard on this Riddles soil. Droughtiness is a limitation, especially for shallow-rooted crops, during prolonged periods of low rainfall. Runoff is rapid. The content of organic matter is moderate.

This soil is suited to row crops if erosion is controlled. Most areas are used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. Some areas are used for woodland. Limitations are moderate for most nonfarm uses. Capability unit IIIe–5; woodland group 1o1.

RsD2—Riddles sandy loam, 12 to 18 percent slopes, eroded. This soil occupies irregularly shaped knolls and narrow breaks along drainageways and depressions in the upland. Slopes are generally less than 150 feet long. Most areas are 5 to 40 acres in size. The profile of this soil is similar to the one described as representative of the series, but the surface layer and subsoil are thinner and the surface layer is lighter in color.

Included with this soil in mapping are small areas where the loamy substratum is at a depth of 30 to 42 inches. Some areas, especially in woodland, are not eroded and nearly all the surface layer remains. In some areas the surface and subsurface layers are loam. Gravel and a few small stones are common on the surface and are mixed throughout the profile.

Erosion is a hazard on this Riddles soil. Droughtiness is a limitation, especially for shallow-rooted crops,

during prolonged periods of low rainfall. Runoff is very rapid. The content of organic matter is moderate.

This soil is well suited to grasses and legumes for hay or pasture and to woodland. Some areas are not well suited, but are used for corn, soybeans, and wheat. Limitations are severe for most nonfarm uses. Capability unit IVe–5; woodland group 1o1.

Sebewa Series

The Sebewa series consists of very poorly drained, medium textured soils that are moderately deep over sand and gravelly sand. These soils formed in medium textured glacial outwash. They occupy depressional areas and drainageways on glacial outwash plains. They are nearly level. The native vegetation was water-tolerant, mixed hardwood trees.

In a representative profile the surface layer is 12 inches of very dark gray loam. The subsoil is about 26 inches thick. In sequence from the top, it is 12 inches of firm, gray sandy clay loam mottled with light olive brown and brown; 10 inches of firm, grayish brown sandy clay loam mottled with light olive brown; and 4 inches of friable, gray gravelly sandy clay loam mottled with light olive brown. The substratum to a depth of about 60 inches is light brownish gray sand and gravelly sand.

Permeability and the available water capacity are moderate. The content of organic matter is high. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Sebewa loam in a cultivated field, 2,140 feet east and 300 feet north of the southwest corner of sec. 4, T. 35 N., R. 8 E.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—9 to 12 inches; very dark gray (10YR 3/1) loam; moderate medium granular structure; friable; black 10YR 2/1) organic stains on faces of peds; neutral; clear smooth boundary.

B21tg—12 to 24 inches; gray (5Y 5/1) sandy clay loam; many fine distinct light olive brown (2.5Y 5/4) mottles and common fine prominent brown (7.5YR 5/4) mottles; moderate fine and medium subangular blocky structure; firm; very dark grayish brown (2.5Y 3/2) clay films on most faces of peds; very dark gray (10YR 3/1) iron- and manganese-oxide concretions; 5 percent fine gravel; neutral; clear wavy boundary.

B22tg—24 to 34 inches; grayish brown (2.5Y 5/2) sandy clay loam; few fine faint light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure; firm; very dark grayish brown (2.5Y 3/2) clay films on some faces of peds; 10 percent fine gravel; neutral; gradual wavy boundary.

B3g—34 to 38 inches; gray (5Y 5/1) gravelly sandy clay loam; common fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; few light gray (10YR 7/1) lime nodules; few strong brown (7.5YR 5/6) iron splotches; strong effervescence; mildly alkaline; clear irregular boundary.

IIC—38 to 60 inches; light brownish gray (10YR 6/2) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The solum ranges from 24 to 40 inches in thickness. The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2) loam or mucky loam and ranges from 10 to 15 inches in thickness. The B21tg and B22tg horizons are clay loam, sandy clay loam, gravelly sandy clay loam, or gravelly clay loam. In some pedons the B3g horizon is heavy loam. The IIC horizon is mostly fine gravel or coarse sand in some pedons.

Sebewa soils are similar to Gilford and Rensselaer soils. They contain more clay in the subsoil than Gilford soils, and they contain less silt or fine sand and are coarser textured in the substratum than Rensselaer soils.

Se—Sebewa loam. This soil occupies broad, flat depressional areas and long, narrow drainageways in glacial outwash plains. Slopes are 0 to 2 percent. Areas are irregular in shape and are 10 to 100 acres in size.

Included with this soil in mapping are small areas of Homer loam on low rises and adjacent flats. In places the surface layer and upper part of the subsoil are sandy loam. Deep depressional areas 3 to 5 acres in size where the surface layer is muck or mucky loam are identified by spot symbols on the soil map. In some areas in the northwestern part of the county, the upper part of the substratum has strata of gravelly loam or gravelly sandy loam 4 to 12 inches thick. Some areas near the Elkhart River are frequently flooded or have a high water table most of the time and are underlain with calcareous, loose sand and gravelly sand at a depth of 10 to 24 inches. Many of these frequently flooded areas have accumulations of reddish brown iron-oxide in the subsoil. These areas and undrained areas that are too wet for commonly grown crops are identified by spot symbols on the soil map.

Wetness is a limitation on this very poorly drained Sebewa soil, and drainage is needed. The content of organic matter is high.

This soil is suited to row crops each year if it is drained. It is used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. Undrained areas are suitable for pasture and woodland. Limitations are severe for most nonfarm uses. Capability unit IIw–4; woodland group 2w11.

Shoals Series

The Shoals series consists of deep, somewhat poorly drained, medium textured soils. These nearly level soils formed in medium textured and moderately coarse textured alluvium on bottom land. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 12 inches of dark grayish brown silt loam. The underlying material to a depth of 60 inches is in sequence downward, 9 inches of mottled brown, grayish brown, and reddish brown silt loam; 12 inches of grayish brown loam mottled with yellowish brown and dark brown; 6 inches of grayish brown light clay loam mottled with dark brown and yellowish brown; 21 inches of grayish brown, stratified silt loam, loam, light clay loam, and sandy loam mottled with dark brown and yellowish brown.

Permeability is moderate, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow. These soils are subject to occasional flooding, and wetness is a limitation. The sea-

sonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Shoals silt loam in a cultivated field, 1,225 feet west and 150 feet north of the southeast corner of sec. 24, T. 34 N., R. 11 E.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; neutral; clear smooth boundary.

C1—12 to 21 inches; mottled brown (10YR 5/3), grayish brown (10YR 5/2), and reddish brown silt loam; weak fine subangular blocky structure; friable; few voids filled with dark grayish brown (10YR 4/2) silt loam; neutral; clear wavy boundary.

C2—21 to 33 inches; grayish brown (10YR 5/2) loam; common fine distinct yellowish brown (10YR 5/4) mottles and few fine prominent dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; few dark reddish brown (5YR 3/2) iron- and manganese-oxide concretions; about 1 inch of sandy loam strata, 1/8 to 1/4 inch thick; neutral; clear wavy boundary.

C3—33 to 39 inches; grayish brown (10YR 5/2) light clay loam; common fine prominent dark brown (7.5YR 4/4) mottles and many fine distinct yellowish brown (10YR 5/4) mottles; massive; firm; neutral; clear wavy boundary.

C4—39 to 60 inches; grayish brown (10YR 5/2) stratified silt loam, loam, light clay loam, and sandy loam; common fine distinct yellowish brown (10YR 5/4) mottles and few fine prominent dark brown (7.5YR 4/4) mottles; massive; friable; moderate effervescence; mildly alkaline.

The Ap horizon ranges from dark grayish brown (10YR 4/2) to grayish brown (10YR 5/2). The C1, C2, and C3 horizons have granular structure in some pedons. They are dominantly silt loam or loam, but some pedons have minor horizons of sandy loam or clay loam. The C4 horizon contains strata of sand or gravelly sand in some pedons.

Shoals soils are associated with Wallkill and Washtenaw soils. They lack the buried organic horizon of Wallkill soils and the buried, dark A horizon of Washtenaw soils.

Sh—Shoals silt loam. This nearly level soil is on narrow bottom land along streams. Slopes are 0 to 2 percent. Most areas are long and are 5 to 30 acres in size.

Included with this soil in mapping are areas of a moderately well drained soil on slightly higher bottom land where the surface layer is loam or fine sandy loam and the lower horizons are loam, light clay loam, or light sandy clay loam. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. In some places the surface layer is loam.

Wetness is a limitation on this Shoals soil, and drainage is needed. Flooding is a slight hazard. Areas where stream channels are deep are not flooded. Maintaining the supply of organic matter is a management need.

This soil is suited to row crops each year. Most drained areas are used for corn, soybeans, and pasture. Some undrained areas are used for woodland or pasture. Limitations are severe for most nonfarm uses. Capability unit IIw–7; woodland group 2o13.

Toledo Series

The Toledo series consists of deep, very poorly drained, moderately fine textured soils. The soils formed in fine textured sediment that settled out of still water. They occupy depressional areas of the upland and outwash plains. They are nearly level. The native vegetation was water-tolerant hardwood trees.

In a representative profile the surface layer is 8 inches of very dark gray silty clay loam. The subsoil is about 36 inches thick. In sequence from the top, it is 7 inches of very firm, dark gray light silty clay mottled with olive brown; 19 inches of very firm, gray silty clay mottled with olive brown and strong brown; 5 inches of very firm, dark gray silty clay mottled with olive brown and yellowish brown; and 5 inches of very firm, gray silty clay mottled with olive brown and yellowish brown. The substratum to a depth of about 60 inches is gray silty clay mottled with olive brown and yellowish brown.

Permeability is slow, and the available water capacity is high. The content of organic matter is high. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture.

Representative profile of Toledo silty clay loam in a cultivated field, 450 feet west and 25 feet north of the southeast corner of sec. 20, T. 33 N., R. 9 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and medium granular structure; firm; neutral; abrupt smooth boundary.

B21g—8 to 15 inches; dark gray (10YR 4/1) light silty clay; common fine distinct olive brown (2.5Y 4/4) mottles; strong fine angular blocky structure; very firm; very dark gray (10YR 3/1) silty clay loam fillings in voids and cracks; many fine pores on faces of peds; neutral; clear wavy boundary.

B22g—15 to 24 inches; gray (5Y 5/1) silty clay; common fine distinct olive brown (2.5Y 4/4) mottles and few fine prominent strong brown (7.5YR 5/6) mottles; strong medium angular blocky structure; very firm; common fine and medium pores on faces of peds and few patchy dark gray (5Y 4/1) clay films; neutral; gradual wavy boundary.

B23g—24 to 34 inches; gray (5Y 5/1) silty clay; common fine distinct olive brown (2.5Y 4/4) mottles and few fine prominent strong brown (7.5YR 5/6) mottles; weak medium and coarse prismatic structure parting to strong medium and coarse angular and subangular blocky; very firm; few iron- and manganese-oxide concretions; neutral; gradual wavy boundary.

B24g—34 to 39 inches; dark gray (5Y 4/1) silty clay; common fine distinct olive brown (2.5Y 4/4) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to strong coarse angular blocky and subangular blocky; very firm; many iron- and manganese-oxide concretions; neutral; clear wavy boundary.

B3g—39 to 44 inches; gray (5Y 5/1) silty clay; common fine distinct olive brown (2.5Y 4/4) and yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure parting to weak coarse subangular blocky; very firm; faces of peds covered with thick light gray (10YR 7/1) lime coatings on vertical faces of prisms; mildly alkaline on faces of peds, neutral in interior; gradual wavy boundary.

C—44 to 60 inches; gray (5Y 5/1) silty clay; common fine distinct olive brown (2.5Y 4/4) mottles and few fine distinct yellowish brown (10YR 5/6) mottles; massive; very firm; strong effervescence; moderately alkaline.

The solum ranges from 36 to 50 inches in thickness. The Ap and A12 horizons, if they occur, are silty clay loam or mucky loam less than 10 inches thick. The Ap horizon ranges from black (10YR 2/1) to very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The B22g, B23g, and B24g horizons are heavy silty clay loam, silty clay, or clay. The C horizon is dominantly silty clay or clay, but some pedons have thin strata of silty clay loam, silt loam, or silt.

Toledo soils are similar to Milford and Pewamo soils. They contain more clay in the subsoil and substratum than Milford or Pewamo soils.

To—Toledo silty clay loam. This soil occupies broad depressional areas of the upland and outwash plains. Most areas are irregular in shape and are 5 to 100 acres in size.

Included with this soil in mapping are small areas of Fulton silt loam on low rises and adjacent flats. In some areas the surface layer is 10 to 18 inches thick. In some, it is dark gray. In others it is silt loam, and in a few areas north of Big Lake it is fine sandy loam. In some areas thin strata of silt loam or silt are in the lower part of the B horizon. Undrained areas that are too wet for commonly grown crops and deep depressional areas 3 to 5 acres in size where the surface layer is muck or mucky loam are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Toledo soil, and drainage is needed. The soil is sticky when wet and hard and cloddy when dry. Special blinding around tile is needed to improve the water intake rate. Maintaining tilth is a management need.

This soil is suited to row crops each year. Most drained areas are used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. Some areas are used for woodland. Limitations are severe for most nonfarm uses. Capability unit IIw–1; woodland group 2w11.

Wallkill Series

The Wallkill series consists of deep, very poorly drained, medium textured soils. These nearly level soils are in depressional areas of the upland and outwash plains. The depressions were formerly marsh areas in which plant remains accumulated over a long period and were later covered with alluvial mineral soil material. The soils formed in recently deposited alluvium and in the underlying, buried organic soil. The native vegetation was cattails, sedges, and water-tolerant trees, shrubs, and grasses.

In a representative profile the surface layer is 8 inches of dark gray silt loam. The underlying mineral material is 19 inches thick. In sequence from the top, it is 6 inches of dark grayish brown silt loam; 4 inches of dark grayish brown light silty clay loam mottled with brown; and 9 inches of very dark gray silt loam mottled with grayish brown. The buried organic layer to a depth of 60 inches is black muck.

Permeability is moderate in the alluvium and moderately rapid or rapid in the buried organic material. The available water capacity is very high. The content of organic matter is moderate. Runoff is very slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn or soybeans, and to many grasses for hay and pasture.

Representative profile of Wallkill silt loam in a cultivated field, 1,440 feet east and 100 feet north of the southwest corner of sec. 11, T. 33 N., R. 10 E.

Ap—0 to 8 inches; dark gray (10YR 4/1) silt loam; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

C1g—8 to 14 inches; dark grayish brown (10YR 4/2) silt loam; few very dark gray (10YR 3/1) coatings on peds and in voids; weak medium granular structure; friable; neutral; clear wavy boundary.

C2g—14 to 18 inches; dark grayish brown (10YR 4/2) light silty clay loam; few fine distinct brown (10YR 5/3) mottles; massive; friable; very dark gray (10YR 3/1) organic coatings in cracks and in voids; neutral; clear wavy boundary.

C3g—18 to 27 inches; very dark gray (10YR 3/1) silt loam; common fine distinct grayish brown (10YR 5/2) mottles; massive; friable; black (10YR 2/1) organic coatings in cracks and voids, black (10YR 2/1) sapric material mixed in lower part; neutral; gradual wavy boundary.

IIOa1—27 to 36 inches; black (10YR 2/1) rubbed sapric material; about 30 percent fiber, less than 10 percent rubbed; massive; friable; brown (10YR 5/3) herbaceous fibers; slightly acid; gradual wavy boundary.

IIOa2—36 to 60 inches; black (10YR 2/1) rubbed sapric material; about 40 percent fiber, less than 10 percent rubbed; massive; friable; brown (10YR 4/3) herbaceous fibers; slightly acid.

The mineral soil over the organic horizon ranges from 16 to 36 inches in thickness. The Ap horizon is dark brown (10YR 3/3), dark gray (10YR 4/1), or dark grayish brown (10YR 4/2). The C1, C2, and C3 horizons are silt loam, loam, clay loam, or silty clay loam. The underlying IIO horizon is sapric or hemic material, or a combination of both. The IIOa1 and IIOa2 horizons range from neutral to medium acid and are more than 20 inches thick.

Wallkill soils are associated with Houghton, Adrian, Palms, and Edwards soils. They differ from those soils in having an alluvial mineral horizon over an organic horizon.

Wa—Wallkill silt loam. This soil occupies deep, irregularly shaped depressional areas of the upland. Slopes are 0 to 2 percent. Areas are mainly long and narrow and are below eroded slopes. They are 3 to 20 acres in size.

Included with this soil in mapping are small, narrow areas of Washtenaw silt loam around the edge of depressions. In a few places the surface layer is loam or silty clay loam. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map. In a few areas the mineral soil is 10 to 16 inches deep over the muck.

Wetness is a serious limitation on this Wallkill soil. Drainage is needed.

This soil is suited to row crops each year. Most areas are used for corn, soybeans, and small grain or for grasses for hay and pasture. Limitations are severe for most nonfarm uses. Capability unit IIIw–11; woodland group 4w23.

Warsaw Series

The Warsaw series consists of well drained, medium textured soils that are moderately deep over sand and gravelly sand. These soils formed in medium textured glacial outwash on outwash plains. They are nearly level. The native vegetation was prairie grasses and scattered trees.

In a representative profile the surface layer is very dark brown loam 14 inches thick. The subsoil is about 21 inches thick. In sequence from the top, it is 3 inches

of friable, dark brown loam; 12 inches of firm, brown sandy clay loam; 4 inches of friable, brown loam; and 2 inches of firm, very dark brown gravelly sandy clay loam. The substratum to a depth of about 60 inches is brown, stratified sand and gravelly sand.

Permeability and the available water capacity are moderate. The content of organic matter is high. Runoff is slow. Droughtiness is a limitation.

These soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Because of droughtiness, crops that mature early in the season are best suited.

Representative profile of Warsaw loam in a cultivated field, 1,440 feet east and 425 feet south of the northwest corner of sec. 2, T. 35 N., R. 8 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 14 inches; very dark brown (10YR 2/2) loam; weak fine and medium granular structure; friable; neutral; clear wavy boundary.

B1—14 to 17 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; 5 percent gravel; slightly acid; clear wavy boundary.

B21t—17 to 29 inches; brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; thin dark brown (7.5YR 3/2) clay films on most faces of peds; 10 percent fine gravel; medium acid; clear wavy boundary.

B22t—29 to 33 inches; brown (7.5YR 4/4) loam; weak fine and medium subangular blocky structure; friable; thin dark brown (7.5YR 3/2) clay films on faces of some peds and as linings in some voids; 10 percent fine gravel; slightly acid; clear irregular boundary.

B23t—33 to 35 inches; very dark brown (10YR 2/2) gravelly sandy clay loam; weak medium subangular blocky structure; firm; medium black (10YR 2/1) organic and clay films on faces of all peds and in linings of voids and on pebble surfaces; tongues extend into the IIC horizon; neutral; abrupt irregular boundary.

IIC—35 to 60 inches; brown (10YR 5/3) stratified sand and gravelly sand; single grained; loose; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to the IIC horizon range from 30 to 40 inches. The A horizon ranges from 12 to 18 inches in thickness and is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). Some pedons do not have a B1 horizon. The B21t and B22t horizons are dominantly sandy clay loam or gravelly sandy clay loam and range from 12 to 24 inches in thickness. Some B2 subhorizons are loam, heavy sandy loam, or gravelly sandy loam in some pedons. The content of fine gravel ranges from 5 to 15 percent in the upper part of the B horizon to 10 to 30 percent in the lower part. The B23t horizon ranges from 1 inch to 6 inches in thickness and is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2).

Warsaw soils are similar to Fox and Casco soils. They have a darker surface layer than both of those soils and a thicker B horizon and a deeper solum than Casco soils.

WrA—Warsaw loam, 0 to 2 percent slopes. This nearly level soil occupies broad flats and long, narrow, closed and shallow depressional areas of outwash plains. There are also many shallow potholes and long depressional areas 1 foot to 2 feet deep. Most areas are 40 to 640 acres in size.

Included with this soil in mapping are many small areas, especially on low rises between depressions and potholes, where the surface layer is sandy loam and the subsoil is mostly sandy loam or gravelly sandy loam. Some small areas have less than 10 inches of dark colored surface material. Potholes ½ acre to 2 acres in size and having 2 to 6 percent slopes are identified by spot symbols on the soil map. Also included along drainageways are areas generally less than 100 feet wide where slopes are 2 to 6 percent.

Erosion is a hazard on this Warsaw soil. Droughtiness is a limitation, especially for shallow-rooted crops. The soil absorbs water readily and is easy to work.

This soil is suited to row crops year after year. Most areas are used for corn and soybeans. Some areas are used for small grain and for hay or pasture. Limitations are slight for most nonfarm uses. Capability unit IIs–2; woodland group not assigned.

Washtenaw Series

The Washtenaw series consists of deep, very poorly drained, medium textured soils. These soils formed in recently deposited, medium textured alluvium and in the underlying, buried depressional soil that is dark in color and very poorly drained. They occupy depressional areas of the upland and outwash plains. The native vegetation was water-tolerant, mixed hardwood trees.

In a representative profile the surface layer is 8 inches of brown silt loam. The subsoil is about 20 inches thick. The upper part is 12 inches of friable, dark grayish brown silt loam, and the lower part is 8 inches of friable, dark grayish brown silt loam mottled with brown. The buried surface layer is 11 inches of friable, very dark gray heavy silt loam and 9 inches of firm, very dark gray silty clay loam. The buried subsoil to a depth of about 60 inches is dark gray silty clay mottled with olive brown and gray.

Permeability is slow, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow. Some areas are ponded. Wetness is a serious limitation. The seasonal high water table is at or near the surface.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Washtenaw silt loam in a cultivated field, 1,250 feet east and 850 feet north of the southwest corner of sec. 14, T. 33 N., R. 10 E.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; weak fine granular structure; friable; neutral; abrupt smooth boundary.

C1—8 to 20 inches; dark grayish brown (10YR 4/2) silt loam; weak medium and coarse granular structure; friable; neutral; clear wavy boundary.

C2—20 to 28 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint brown (10YR 4/3) mottles; massive; friable; neutral; clear wavy boundary.

A11b—28 to 39 inches; very dark gray (10YR 3/1) heavy silt loam; moderate fine subangular blocky structure; friable; black (10YR 2/1) organic coatings on peds; neutral; clear wavy boundary.

A12b—39 to 48 inches; very dark gray (10YR 3/1) silty clay loam; moderate medium subangular blocky structure; firm; few fine pebbles; few black (N 2/0) organic coatings on peds and few dark yellowish brown (10YR 4/4) herbaceous fibers; neutral; clear wavy boundary.

B21gb—48 to 60 inches; dark gray (5Y 4/1) silty clay; common fine prominent olive brown (2.5Y 4/4) mottles and common fine distinct gray (5Y 6/1) mottles; moderate medium and coarse subangular blocky structure; firm; few fine pebbles; very dark gray (10YR 3/1) organic coatings in vertical cracks, on pebbles, and in linings of voids; neutral.

The alluvial overwash material ranges from 20 to 40 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), brown (10YR 4/3), or dark yellowish brown (10YR 3/4). The C1 and C2 horizons are dark grayish brown (10YR (4/2), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) silt loam or loam and have a very weakly developed structure in some pedons. The A11b horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or black (10YR 2/1) loam to silty clay loam. The B21gb horizon ranges from sandy clay loam to silty clay or clay.

Washtenaw soils are associated with Pewamo and Brookston soils. They differ in having overwash surface and subsoil horizons.

Ws—Washtenaw silt loam. This soil occupies depressional areas of the upland and outwash plains where alluvial material has recently been deposited. These depressional areas are narrow or small, or the part occupied by this soil is a narrow band near the edge of the area. All are below and adjacent to severely eroded, moderately sloping to steep areas. Most are 2 to 10 acres in size.

Included with this soil in mapping are small areas where the alluvial overwash is less than 20 inches thick. Also included are a few areas where a thin layer of muck is beneath the overwash. In a few areas the surface layer is loam or sandy loam. Areas ½ acre to 2 acres in size that are too wet for commonly grown crops are identified by spot symbols on the soil map.

Wetness is a serious limitation on this Washtenaw soil, and drainage is needed. Erosion is a hazard along narrow drainageways during periods of heavy rainfall.

This soil is suited to row crops each year. Most drained areas are used for corn, soybeans, and wheat or for grasses and legumes for hay or pasture. Some areas are used for woodland. Limitations are severe for most nonfarm uses. Capability unit IIw–1; woodland group 2w11.

Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, medium textured soils. These soils formed in silty and sandy sediment that settled out of slow-moving water in shallow lakes and glacial drainageways. They occupy the upland or outwash plains. They are nearly level. The native vegetation was mixed hardwood trees.

In a representative profile the surface layer is 7 inches of dark grayish brown loam. The subsurface layer is 2 inches of grayish brown heavy loam mottled with yellowish brown. The subsoil is about 29 inches thick. In sequence from the top, it is 4 inches of firm, grayish brown clay loam mottled with yellowish brown and brown; 7 inches of firm, grayish brown clay loam mottled with yellowish brown; 10 inches of firm, yellowish brown clay loam mottled with grayish brown and strong brown; and 8 inches of firm, grayish brown clay loam mottled with yellowish brown. The substratum to a depth of about 60 inches is light olive brown, stratified fine sand, sandy loam, and silt mottled with grayish brown.

Permeability is moderate, and the available water capacity is high. The content of organic matter is moderate. Runoff is slow. Wetness is a limitation. The seasonal high water table fluctuates between depths of 1 foot and 3 feet.

Drained areas of these soils are suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Undrained areas are suitable for pasture or woodland.

Representative profile of Whitaker loam in a cultivated field, 825 feet west and 1,390 feet south of the northeast corner of sec. 23, T. 35 N., R. 9 E.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—7 to 9 inches; grayish brown (10 YR 5/2) heavy loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium granular structure; friable; many fine pores; dark grayish brown (10YR 4/2) loam fillings in some voids; neutral; clear smooth boundary.

B21tg—9 to 13 inches; grayish brown (10YR 5/2) clay loam; many fine distinct yellowish brown (10YR 5/6) mottles and few fine distinct brown (7.5YR 4/4) mottles; moderate very fine and fine subangular blocky structure; thin discontinuous dark grayish brown (10YR 4/2) clay films on faces of peds and in linings of voids; firm; slightly acid; clear smooth boundary.

B22tg—13 to 20 inches; grayish brown (10YR 5/2) clay loam; many fine distinct yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; continuous medium dark grayish brown (10YR 4/2) clay films on faces of peds and in linings of voids; few black (10YR 2/1) iron- and manganese-oxide concretions; slightly acid; clear smooth boundary.

B23t—20 to 30 inches; yellowish brown (10YR 5/4) clay loam; many fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; continuous medium dark grayish brown (10YR 4/2) clay films on faces of peds and in linings of voids; few black (10YR 2/1) iron- and manganese-oxide concretions; slightly acid; gradual wavy boundary.

B24tg—30 to 38 inches; grayish brown (2.5Y 5/2) clay loam; many fine distinct yellowish brown (10YR 5/4 and 5/6) mottles; weak coarse subangular blocky structure; firm; discontinuous thin dark grayish brown (10YR 4/2) clay films on vertical ped faces and in linings of voids; few black (10YR 2/1) iron- and manganese-oxide concretions; neutral; clear wavy boundary.

C—38 to 60 inches; light olive brown (2.5Y 5/4) stratified fine sand, sandy loam, and silt; many fine prominent grayish brown (10YR 5/2) mottles; massive; very friable; strong effervescence; moderately alkaline.

The solum ranges from 36 to 48 inches in thickness. The Ap horizon is dark grayish brown (10YR 4/2) and brown (10YR 4/3 or 10YR 5/3). In some pedons the A2 horizon has been mixed with the Ap horizon by cultivation. Some pedons have a B1 horizon of loam or light clay loam. The B22tg, B23t, and B24tg horizons are dominantly clay loam, but in some pedons they are sandy clay loam or loam. The C horizon is dominantly stratified sand and silt and minor strata of sandy loam and loam.

Whitaker soils are associated with Homer and Aubbeenaubbee soils. They contain less sand and gravelly sand in the subsoil and substratum than Homer soils and lack the fine sandy loam surface layer and loam substratum of Aubbeenaubbee soils.

Wt—Whitaker loam. This soil occupies broad irregularly shaped flats and narrow drainageways of the upland and outwash plains. Slopes are 0 to 2 percent. Most areas are 3 to 15 acres in size.

Included with this soil in mapping are small areas of Rensselaer loam in narrow drainageways. In some areas the surface layer is fine sandy loam and the upper part of the subsoil is loam or sandy clay loam. In places, depth to the calcareous substratum is 30 to 36 inches.

Wetness and a fluctuating seasonal high water table 1 foot to 3 feet deep are limitations on this Whitaker soil. Maintaining the supply of organic matter is a management need.

This soil is suited to row crops most of the time if it is drained. Most areas are used for corn, soybeans, and small grain. A few areas are used for hay and pasture or for woodland. Limitations are moderate or severe for most nonfarm uses. Capability unit IIw–2; woodland group 3o5.

Use and Management of the Soils

This part of the survey contains information on the use and management of the soils of Noble County for cultivated crops and forage and shows predicted yields of important crops. It also describes the use of soils for wildlife, trees, engineering structures and practices, town and country planning, and recreation.

Specific management for individual soils is not suggested in this section. Detailed information on use and management can be provided by the local district conservationist of the Soil Conservation Service or by the Noble County Cooperative Extension Service.

Crops

About 76 percent of Noble County is used for crops and pasture. The main crops are corn, soybeans, and small grain and grasses and legumes for forage. A small acreage is used for tomatoes, potatoes, and other special crops.

The main concerns of management are controlling wetness, soil blowing, and water erosion, maintaining fertility and the supply of organic matter, and maintaining or improving tilth. Of the intensively cultivated acreage, about 33 percent is limited by wetness and 58 percent by the hazard of erosion. Only 2 percent has few limitations for crops.

Conservation and management practices that help to overcome soil hazards and limitations are briefly described in the following paragraphs.

Wetness can be overcome on most soils by tile or open ditches. In some areas the water level of adjacent lakes or streams is so high that the soils cannot be drained unless a pumping system is installed. Diversion terraces carry runoff from higher ground to a safe outlet and keep it off of wet soil. A complete tile system is used to drain broad flats or depressional areas. Random tile is used to drain potholes, narrow depressions, and waterways or to intercept seepage on slopes. Special blinding materials keep out sand when sandy soils are tiled. The drainage of slowly permeable clayey soils is improved by partly backfilling the trench with corn cobbs, straw, or similar material.

Open ditches are generally used for tile outlets. Shallow surface drains in some areas remove excess water and prevent ponding. Some areas of muck and of soils on outwash plains are drained by a system of open ditches. Control of the water table is necessary in these areas because excessive drainage makes soils on outwash plains droughty and increases the rate of oxidation and subsidence of muck.

Soil blowing on coarse textured soils and organic soils can be controlled by keeping the soil covered with close-growing crops, leaving crop residue on the surface, and growing winter crops. Windbreaks also control soil blowing. Soils that have a rough cloddy surface are less susceptible to soil blowing than are other soils.

The hazard of water erosion can be controlled under good management. A dense sod in waterways prevents gullying.

Terraces with proper outlets or contour stripcropping help control erosion. In places large diversion terraces are needed to intercept runoff from sloping areas and carry it to a safe outlet. Contour cultivation helps slow runoff and control erosion.

Erosion can also be controlled by growing close-growing crops, such as grasses and legumes in rotations. The more sloping soils require these crops in the rotation more of the time. Some soils are suitable only for grasses and legumes for hay and pasture or for woodland.

Conservation practices that help to increase content of organic matter, improve tilth, and prevent erosion are leaving crop residue on the surface, growing green manure crops, and applying livestock manure. A balanced fertilization program helps to control erosion by improving crops. When wet, soils should not be worked or trampled by livestock if good tilth is to be maintained.

Crops on all the soils in the county need fertilizer, and lime is needed on many soils. Dark colored, mineral soils in depressional areas and nearly level soils on bottom land generally do not need lime. The kind and amount of fertilizer and lime to be applied should be determined by soil tests.

Droughtiness on coarse textured soils and soils underlain by sand and gravel can be overcome by irrigation. Irrigation is economically feasible for many high-value special crops and for some commonly grown crops during some seasons if adequate water is available. Crops can withstand the stresses of drought if an adequate supply of fertilizer is applied. Crop selection, timeliness of tillage operations, and effective weed control help to overcome this limitation. Crop residue left on the surface helps to control erosion and decrease moisture loss through evaporation.

On the pages that follow, the capability grouping system used by the Soil Conservation Service is explained, the soils in each capability unit are described, and management suited to the soils in each unit is suggested. Predicted yields of the principal crops are listed for all the soils in the county.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to cranberries,

horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for wildlife, forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode, but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. (None in Noble County.)

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, water supply, or to esthetic purposes. None in Noble County.)

CAPABILITY SUBCLASSES are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I, there are no subclasses because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c* because the soils in Class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, hay, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIe–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Capability unit numbers are generally assigned locally, but are part of a statewide system. All of the units in the system are not represented in Noble County; therefore, the capability unit numbers in this survey are not consecutive.

The soils in Noble County that have been assigned to the same capability unit have about the same limitations, are subject to similar risks of damage, need about the same kind of management, and respond to management in about the same way. Lake borders and Marsh have not been assigned to a capability unit because their properties are too variable.

On the following pages, each capability unit is described and management for each is suggested. To find the capability unit to which a soil has been assigned, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I–1

In this unit are deep, nearly level, moderately well drained or well drained soils on uplands. They have a medium textured surface layer; a moderately fine textured or fine textured subsoil; and a medium textured, moderately fine textured, or fine textured substratum. The content of organic matter is moderate or high. The available water capacity is high, and permeability is moderate, slow, or very slow. Runoff is slow. The seasonal high water table is below 6 feet or at a depth of 3 to 6 feet.

The soils are well suited to all crops commonly grown in the county. Corn, soybeans, and wheat are the main crops, and sweet corn, tomatoes, and other special crops are also suited. Alfalfa, red clover, bromegrass, and orchardgrass are grown for hay and pasture. Row crops can be grown year after year.

The principal management needs are maintenance and improvement of fertility, organic-matter content, and tilth. Crop residue, winter cover crops, and green manure crops help to maintain a desirable level of organic matter and good tilth.

CAPABILITY UNIT I–3

The one soil in this unit, Riddles sandy loam, 0 to 2 percent slopes, is a deep, well drained, nearly level soil on uplands. It has a moderately coarse textured surface layer, a moderately fine textured subsoil, and a medium textured substratum. The content of organic matter is moderate. The available water capacity is

high, and permeability is moderate. The seasonal high water table is below 6 feet. Runoff is slow.

Corn, soybeans, wheat, and oats and legume-grass mixtures for hay and pasture are the main crops. Alfalfa, red clover, bromegrass, orchardgrass, and tall fescue are suitable for hay and pasture. Row crops can be grown year after year.

The principal management needs are moisture conservation and improvement of organic-matter content and fertility. The soil is very friable, is easy to work, and has good tilth. Crop residue, winter cover crops, and green manure crops help to maintain a desirable level of organic matter and good tilth.

CAPABILITY UNIT IIe-1

In this unit are deep, moderately well drained or well drained, gently sloping soils on uplands. They have a medium textured surface layer, a moderately fine textured or fine textured subsoil, and a medium textured to fine textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is moderate, slow, or very slow. Runoff is medium or rapid. The seasonal high water table is below 6 feet or at a depth of 3 to 6 feet. Water erosion is a hazard.

Corn, soybeans, and wheat or oats are the main crops, and tomatoes, sweet corn, and other special crops are also suited. Alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are suitable for hay and pasture. Row crops can be grown most of the time if erosion is controlled. Many different cropping combinations are suitable for these soils.

The principal management needs are prevention of erosion and maintenance or improvement of tilth, organic-matter content, and fertility. Drainage is needed in a few small areas on slopes that are wet as a result of seepage. These soils are easy to work, but become hard and cloddy if worked when wet. Crop residue, winter cover crops, minimum tillage, and grass-legume mixtures help to control erosion and to maintain tilth. Grassed waterways, diversions, terraces, and contour cultivation also help to control erosion.

CAPABILITY UNIT IIe-2

The one soil in this unit, Fox sandy loam, 2 to 6 percent slopes, is a moderately deep, gently sloping, well drained soil on outwash plains and in the upland. It has a moderately coarse textured surface layer, a moderately fine textured subsoil, and a coarse textured substratum. The content of organic matter is moderate. The available water capacity and permeability are moderate. Runoff is medium. The seasonal high water table is below 6 feet. Erosion is a hazard and droughtiness is a limitation.

Corn, soybeans, and wheat and alfalfa, red clover, bromegrass, and orchardgrass for hay and pasture are the main crops. Many vegetable crops are suited if irrigated. Row crops can be grown most of the time.

The principal management needs are prevention of erosion, moisture conservation, and improvement of organic-matter content and fertility. This soil is very friable and easy to work. It can be worked soon after rain without damaging tilth. Minimum tillage, crop residue, and winter cover crops help to control erosion and to maintain good tilth. Grassed waterways, terraces, and contour cultivation also help to control erosion.

CAPABILITY UNIT IIe-5

In this unit are deep, moderately well drained and well drained, gently sloping soils on uplands. They have a moderately coarse textured surface layer and a medium textured to fine textured subsoil and substratum. The content of organic matter is moderate. The available water capacity is high, and permeability ranges from very slow to moderate. Runoff is medium. The seasonal high water table is below 6 feet or at a depth of 3 to 6 feet. Erosion is a hazard. Droughtiness is a limitation, especially for shallow-rooted crops, during prolonged periods of low rainfall.

Corn, soybeans, and wheat or oats are the main crops, and tomatoes, sweet corn, and other special crops are also suited. Alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are suitable for hay and pasture. Row crops can be grown most of the time if erosion is controlled. Many combinations of cropping systems are suited to these soils, including intensively cultivated crops.

The principal management needs are prevention of erosion and maintenance or improvement of organic-matter content and fertility. These soils are easy to work, and tilth is good. Some included soils that have a medium textured surface layer are not droughty. Crop residue, minimum tillage, winter cover crops, and grass-legume mixtures help to control erosion, maintain good tilth, and improve soil fertility. Grassed waterways, diversions, terraces, and contouring also help to control erosion.

CAPABILITY UNIT IIe-6

The one soil in this unit, Morley silt loam, 2 to 6 percent slopes, eroded, is a deep, moderately well drained or well drained, gently sloping soil on uplands. It has a medium textured surface layer, a fine textured subsoil, and a moderately fine textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is slow. Runoff is rapid. The seasonal high water table is 3 to more than 6 feet deep. Water erosion is a hazard.

Corn, soybeans, and wheat or oats are the main crops. Alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are suitable for hay and pasture. Row crops can be grown most of the time if erosion is controlled.

The principal management needs are prevention of erosion and improvement of tilth, organic-matter content, and fertility. The soil becomes hard and cloddy if worked or pastured when wet. Drainage is needed in a few areas on slopes and in drainageways that are wet as a result of seepage. Crop residue, winter cover crops, green manure crops, and minimum tillage help to control erosion and maintain a desirable level of organic matter and soil tilth. Diversions, terraces, contour farming, and grassed waterways help to control runoff.

CAPABILITY UNIT IIe-11

The one soil in this unit, Martinsville fine sandy loam, 2 to 6 percent slopes, is a deep, well drained,

gently sloping soil on outwash plains and in the upland. It has a moderately coarse textured surface layer, a moderately fine textured subsoil, and a medium textured or moderately coarse textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is moderate. Runoff is medium. The seasonal high water table is below 6 feet. Erosion is the main limitation.

This soil is suited to all crops commonly grown in the county. Corn, soybeans, and wheat and grasses and legumes for hay and pasture are the main crops. Alfalfa, red clover, bromegrass, orchardgrass, nursery stock, and berries are also suited. Many cropping systems, including row crops most of the time, are suitable if erosion is controlled.

The principal management needs are control of erosion and maintenance or improvement of organic-matter content and fertility. Droughtiness is a concern for shallow-rooted crops during prolonged periods of low rainfall. This soil has good tilth and is easy to work. Minimum tillage, crop residue, and green manure crops help to improve or maintain the level of organic matter and tilth. Along with contour farming, terraces, and grassed waterways, they also help to control runoff and erosion.

CAPABILITY UNIT IIe-13

The one soil in this unit, Blount silt loam, 2 to 4 percent slopes, eroded, is a deep, somewhat poorly drained, gently sloping soil on uplands. It has a medium textured surface layer, a fine textured subsoil, and a moderately fine textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is slow. Runoff is medium. The seasonal high water table is at a depth of 1 foot to 3 feet. Erosion is a hazard, and wetness is a limitation.

Corn, soybeans, and wheat or oats are the main crops. Alfalfa, clover, bromegrass, orchardgrass, and tall fescue are suitable for hay or pasture, but the selection of legumes depends on drainage. Many combinations of cropping systems are suited to this soil, including intensively cultivated crops.

The principal management needs are protection from erosion, drainage, and maintenance or improvement of tilth, organic-matter content, and fertility. Compaction and puddling cause poor tilth if this soil is worked or pastured when wet. Crop residue, winter cover crops, green manure crops, and minimum tillage help to control erosion, maintain a desirable level of organic matter, and improve soil tilth. Grassed waterways permit surface water to cross this soil without creating gullies or intensifying siltation. Although contouring helps to control erosion, it commonly increases wetness by retarding surface runoff. Adequate drainage is needed if this soil is to be used for corn, soybeans, small grain, alfalfa, and other commonly grown crops.

CAPABILITY UNIT IIw-1

In this unit are deep, poorly drained and very poorly drained, nearly level soils in depressions on outwash plains and in the upland. They have a medium textured or moderately fine textured surface layer and a moderately fine textured, fine textured, or medium textured subsoil. The content of organic matter is high or moderate. The available water capacity is high, and permeability is slow or moderately slow. Runoff is very slow. Some areas are ponded. The seasonal high water table is at or near the surface. Wetness is the main limitation.

Corn, soybeans, and wheat are the main crops, and tomatoes and sugar beets are suited. Alfalfa, red clover, alsike clover, Ladino clover, bromegrass, and orchardgrass are also suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops year after year, are suitable if these soils are adequately drained. Areas that lack drainage outlets are suitable for permanent pasture, woodland, and wetland wildlife habitat.

The principal management needs are drainage and maintenance and improvement of tilth, organic-matter content, and fertility. The tilth of these soils greatly influences their productivity. The plow layer becomes puddled and cloddy if worked when wet. Adequate drainage can be provided for most areas by installing a complete tile system. In places random tile lines are beneficial. Surface drains are sometimes needed to remove accumulated surface water from ponded areas. Where feasible, diversion terraces are useful in intercepting runoff from the uplands. Minimum tillage and crop residue help to prevent surface crusting and to improve soil tilth.

CAPABILITY UNIT IIw-2

In this unit are deep, somewhat poorly drained, nearly level soils on outwash plains and in the upland. They have a medium textured surface layer, a moderately fine textured or fine textured subsoil, and a medium textured to fine textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability ranges from very slow to moderately slow. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. Erosion is a hazard on low knolls or along drainageways where slopes are 2 to 4 percent. Wetness is the main limitation.

Corn, soybeans, and wheat are the main crops, and tomatoes and sugar beets are suited. Alfalfa, clover, and many grasses are suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops most of the time, are suitable if these soils are drained.

The principal management needs are control of wetness and maintenance or improvement of tilth, organic-matter content, and fertility. Crop residue and winter cover crops help to maintain the level of organic matter, improve tilth, and prevent crusting. Minimum tillage helps to reduce puddling of the surface layer.

CAPABILITY UNIT IIw-4

In this unit are very poorly drained, nearly level soils in depressions in outwash plains. They are moderately deep over stratified, loose sand and gravelly sand or are deep. They have a moderately coarse textured or medium textured surface layer, a moderately coarse textured or moderately fine textured subsoil, and a coarse textured substratum. The content of organic matter is high. Tilth is good. The available water ca-

pacity is moderate. Permeability is mostly moderately rapid, but is moderate in some soils. Runoff is very slow. Some areas are ponded. The seasonal high water table is at or near the surface. The major limitation is wetness.

These soils are suited to most commonly grown crops if drained. Corn and soybeans are the main crops, and onions, cabbage, carrots, sweet corn, and tomatoes are suited. Alfalfa, clover, and many grasses and small grains are also suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops year after year, are suitable for these soils. Areas that lack drainage outlets are suitable for permanent pasture, woodland, and wetland wildlife habitat.

The principal management needs are drainage and maintenance of organic-matter content and fertility. Tile or open-ditch drainage is effective in lowering the water table and removing excess water. If tile is laid in the gravelly and sandy substratum, special blinding or filters help to keep the sand from clogging the tile. Excessive drainage causes these soils to become droughty.

CAPABILITY UNIT IIw-6

The one soil in this unit, Homer loam, is a somewhat poorly drained, nearly level soil on outwash plains. It is moderately deep over stratified, loose sand and gravelly sand. It has a medium textured surface layer, a moderately fine textured subsoil, and a coarse textured substratum. The content of organic matter is moderate. The available water capacity and permeability are moderate. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. Wetness is the main limitation.

This soil is suited to commonly grown crops if it is drained. Corn, soybeans, and wheat are the main crops. Alfalfa, clover, and many grasses are suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops year after year, are suitable if this soil is adequately drained.

The principal management needs are drainage and maintenance or improvement of organic-matter content and fertility. Special blinding and filtering material is needed to keep sand from clogging tile drains. This soil becomes droughty if the water table is lowered excessively. Minimum tillage and crop residue help to maintain and improve soil tilth and the level of organic matter. The soil becomes cloddy if worked when wet.

CAPABILITY UNIT IIw-7

The one soil in this unit, Shoals silt loam, is a nearly level, somewhat poorly drained, alluvial soil on flood plains and bottom land. It has a medium textured surface layer and subsoil and a medium textured or moderately coarse textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is moderate. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. Wetness is the main limitation. This soil is subject to ponding or flooding, especially in winter or spring.

This soil is suited to corn and soybeans. It is less suited to wheat, alfalfa, and clover because these crops are subject to damage from ponding and overflow. Row crops can be grown year after year if the soil is adequately drained.

The principal management needs are drainage, protection from flooding, and maintenance and improvement of fertility and organic-matter content. Drainage is not needed in areas of included soils that are moderately well drained. Diversions are needed in some areas for protection from runoff from adjacent uplands. Some areas are used mainly for permanent pasture because there are no suitable drainage outlets.

CAPABILITY UNIT IIw-10

The one soil in this unit, Palms muck, drained, is a deep, very poorly drained, nearly level organic soil in depressional areas in the upland or on outwash plains. It has mixed organic material over moderately coarse textured, medium textured, or moderately fine textured mineral material. The content of organic matter is very high. The available water capacity is very high, and permeability is rapid in the organic material and moderate in the substratum. Runoff is very slow. Some areas are ponded. The seasonal high water table is at or near the surface. This soil has good tilth and is easy to work. Wetness is the main limitation, and soil blowing is a hazard when the soil is dry.

Corn, soybeans, grasses, and many vegetable crops are suited if the soil is drained. Special crops, such as onions, potatoes, carrots, and grass for sod, can be grown. Row crops can be grown year after year.

The principal management needs are maintaining drainage and controlling soil blowing. Tile and open-outlet drainage ditches are commonly used. Drainage permits more rapid oxidation of the muck. Frost damage is a hazard in spring and fall. Fire is a hazard because the organic material burns readily during dry periods.

CAPABILITY UNIT IIw-11

The one soil in this unit, Aubbeenaubbee fine sandy loam, is a deep, somewhat poorly drained, nearly level soil in the upland. It is moderately coarse textured in the surface layer and the upper part of the subsoil. The lower part of the subsoil is moderately fine textured, and the substratum is moderately fine textured or medium textured. The content of organic matter is moderate. The available water capacity is high, and permeability is moderate. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. Wetness is the main limitation.

This soil is suited to commonly grown crops if it is drained. Corn, soybeans, and wheat and grasses and legumes for hay and pasture are the main crops. Heaving is a problem for alfalfa during periods of freezing and thawing. Many cropping systems, including row crops year after year, are suitable for this soil.

The principal management needs are drainage and maintenance or improvement of organic-matter content and fertility. This soil has good tilth and is easy to work. If tile drainage is used, special filters are needed to prevent the sand from seeping into and filling the tile lines. Proper location of tile lines to intercept underground seepage is important.

CAPABILITY UNIT IIs–2

In this unit are nearly level, well drained soils on outwash plains. They are moderately deep over stratified, loose sand and gravelly sand. They have a medium textured, coarse textured, or moderately coarse textured surface layer; a moderately fine textured subsoil; and a coarse textured substratum. The content of organic matter is high or medium. The available water capacity and permeability are moderate. Runoff is slow. The seasonal high water table is below 6 feet. Droughtiness is a limitation.

Corn, soybeans, and wheat are the main crops. Alfalfa, red clover, bromegrass, and orchardgrass are suitable for hay and pasture. Many vegetable crops and special crops, such as tomatoes, are suited if irrigated. Many cropping systems, including row crops year after year, are suited.

The principal management needs are moisture conservation and maintenance or improvement of organic-matter content and fertility. These soils are friable and easy to work. Crop residue, cover crops, and minimum tillage help to maintain the level of organic-matter and also control soil blowing.

CAPABILITY UNIT IIIe–1

The one soil in this unit, Miami loam, 6 to 12 percent slopes, eroded, is a deep, well drained, moderately sloping soil on uplands. It has a medium textured surface layer, a moderately fine textured subsoil, and a medium textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is moderate. Runoff is rapid. The seasonal high water table is below 6 feet. Water erosion is a serious hazard.

Corn, soybeans, and wheat or oats are the main crops. Alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are suitable for hay or pasture. Row crops can be grown occasionally if erosion is controlled.

The principal management needs are prevention of erosion and improvement of tilth, organic-matter content, and fertility. This soil is easy to work, but becomes hard and cloddy if worked or pastured when wet. Contouring, stripcropping, grassed waterways, diversion terraces, winter cover crops, and crop residue help to control runoff and erosion. Otherwise, row crops should be limited in the rotation and close-growing crops or grasses and legumes for forage should be grown most of the time. Green manure crops maintain and increase the level of organic matter and improve soil tilth.

CAPABILITY UNIT IIIe–5

In this unit are deep, moderately well drained and well drained, moderately sloping soils on uplands. They have a moderately coarse textured surface layer, a moderately fine textured and fine textured subsoil, and a medium textured to fine textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability ranges from very slow to moderate. The seasonal high water table is 3 to more than 6 feet deep. Runoff is rapid. Erosion is a hazard. Droughtiness is a limitation, especially for shallow-rooted crops, during prolonged periods of low rainfall.

Corn, soybeans, and wheat or oats and legume-grass mixtures for hay and pasture are the main crops. Alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are also suited for hay and pasture (fig. 13). Row crops can be grown frequently if erosion is controlled.

The principal management needs are prevention of erosion and improvement of organic-matter content and fertility. These soils are easy to work and tilth is good. Crop residue, winter cover crops, stripcropping, terracing, and grassed waterways help to control runoff and erosion.

CAPABILITY UNIT IIIe–6

In this unit are deep, moderately well drained or well drained, moderately sloping soils on uplands. They have a moderately coarse textured to moderately fine textured surface layer and a moderately fine textured or fine textured subsoil. The content of organic matter is moderate. The available water capacity is high, and permeability ranges from moderate to very slow. Runoff is rapid. The seasonal high water table is 3 to more than 6 feet deep. Erosion is a serious hazard.

Corn, soybeans, and wheat or oats are the main crops. Alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are suitable for hay or pasture. Row crops can be grown frequently if erosion is controlled.

The principal management needs are prevention of erosion and improvement of organic-matter content, tilth, and fertility. These soils become hard and cloddy if worked or pastured when wet. Drainage is needed in a few small areas on slopes that are wet as a result of seepage. Contour farming, stripcropping, crop residue, and winter cover crops help to control runoff and erosion.

CAPABILITY UNIT IIIe–18

In this unit are deep, well drained, gently sloping and moderately sloping soils in the upland and on outwash plains. They are deep or moderately deep over loose sand and gravelly sand. They have a coarse textured or moderately coarse textured surface layer and a moderately coarse textured to moderately fine textured subsoil. Texture of the substratum is variable. The content of organic matter is moderate or low. The available water capacity is dominantly moderate, and permeability is very rapid to moderate. Runoff ranges from slow to rapid. The seasonal high water table is below 6 feet. Droughtiness is a limitation, and erosion is a hazard. Soil blowing is a hazard for some of these soils.

Corn, soybeans, and wheat and alfalfa, red clover, bromegrass, and orchardgrass for hay and pasture are the main crops. Many vegetable crops and special crops are suited if irrigated.

The principal management needs are prevention of erosion and soil blowing, moisture conservation, and improvement of organic-matter content and fertility. These soils are very friable and easy to work. They can be worked soon after rain without damaging soil tilth. Crop residue, barnyard manure, and green manure crops provide a regular supply of organic matter. Contour farming, stripcropping, and grassed waterways help to reduce soil loss.

Figure 13.—Hay and pasture on gently sloping and moderately sloping soils of capability unit IIIe–5.

CAPABILITY UNIT IIIw–4

The one soil in this unit, Brady sandy loam, is a deep, somewhat poorly drained, nearly level soil on outwash plains. It has a moderately coarse textured surface layer and subsoil and a coarse textured substratum. The content of organic matter is high. The available water capacity is moderate, and permeability is moderately rapid. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. Wetness is the main limitation.

This soil is suitable for commonly grown crops if it is drained. Corn, soybeans, and wheat are the main crops. Alfalfa, clover, and many grasses are also suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops year after year, are suitable for this soil.

The principal management needs are drainage and improvement of organic-matter content and fertility. Special blinding or filtering material is needed to keep sand out of the tile drains. This soil becomes droughty if the water table is lowered excessively. Crop residue and cover crops supply regular additions of organic matter.

CAPABILITY UNIT IIIw–6

The one soil in this unit, Fulton silt loam, is a deep, somewhat poorly drained, nearly level soil. It has a medium textured surface layer and a fine textured subsoil and substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is slow or very slow. Runoff is slow. The seasonal high water table is at a depth of 1 foot to 3 feet. This soil dries out slowly following rains. Wetness is the main limitation.

This soil is suitable for commonly grown crops if it is drained. Corn, soybeans, and wheat are the main crops. Many legumes and grasses are suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops year after year, are suitable for this soil.

The principal management needs are drainage and improvement of tilth, organic-matter content, and fertility. Compaction and puddling leads to poor tilth if this soil is worked or pastured when wet. Special blinding around tile is needed to improve the water intake rate. Minimum tillage, crop residue, and favorable moisture content help to maintain good tilth.

CAPABILITY UNIT IIIw–8

The one soil in this unit, Houghton muck, drained, is a deep, very poorly drained, nearly level soil in depressional areas in the upland and on outwash plains. This soil is mixed organic material to a depth of 51 inches or more. The content of organic matter is very

high. The available water capacity is very high, and permeability is rapid. Runoff is very slow. The seasonal high water table is at or near the surface. Some areas are ponded. Wetness is the main limitation. Soil blowing is a hazard when the muck is dry.

This soil is suited to corn, soybeans, grasses, and many vegetable crops if it is drained. Corn and soybeans are the main crops. Special crops, such as blueberries, onions, potatoes, carrots, and grass for sod, can also be grown. Row crops can be grown year after year.

The principal management needs are maintaining drainage and controlling soil blowing. This soil has good tilth and is easy to work. Drainage permits more rapid oxidation and subsidence of the organic material. Frost damage is a hazard in spring and fall. Fire is a hazard because the organic material burns readily during dry periods. Establishing field windbreaks, using cover crops, and artificially wetting the surface layer help to reduce soil blowing.

CAPABILITY UNIT IIIw–11

The one soil in this unit, Wallkill silt loam, is a deep, very poorly drained soil that is in depressional areas in the upland or on outwash plains. It has medium textured alluvium over buried muck. The content of organic matter is moderate. The available water capacity is very high, and permeability is moderate. Runoff is very slow. The seasonal high water table is at or near the surface. Some areas are ponded. Wetness is the main limitation.

Corn, soybeans, and wheat are the main crops. Red clover, alsike clover, Ladino clover, bromegrass, and orchardgrass are also suited, but the selection of legumes depends on drainage. Many cropping systems, including row crops year after year, are suitable for this soil. Areas that do lack drainage outlets are suitable for permanent pasture, woodland, and wetland wildlife habitat.

The principal management needs are drainage and improvement of organic matter content and fertility. Minimum tillage, crop residue, and green manure crops help to maintain the level of organic matter and good tilth.

CAPABILITY UNIT IIIs–1

The one soil in this unit, Chelsea fine sand, 2 to 6 percent slopes, is a deep, excessively drained, gently sloping soil. It is coarse textured throughout the profile. The content of organic matter is low. The available water capacity is low, and permeability is rapid. Runoff is slow. The seasonal high water table is below 6 feet. Droughtiness is a serious limitation, and soil blowing is a hazard.

This soil is suited to fruit trees, vineyards, and Christmas trees. Alfalfa and bromegrass or orchardgrass are suitable for hay or pasture. Corn and soybeans can be grown, but yields are commonly low because of droughtiness. Early maturing row crops are less affected by drought. Row crops and special crops can be grown year after year if irrigation is feasible. Wheat is suited to this soil.

The principal management needs are prevention of soil blowing, moisture conservation, and improvement of fertility and organic-matter content. This soil is loose and hard to work when dry. Traction is poor for farm machinery. Frequent fertilizer applications are necessary because of rapid leaching of nutrients. Crop residue and cover crops help to improve and maintain the level of organic matter and to reduce soil blowing. Irrigation also helps to reduce the hazard of soil blowing.

CAPABILITY UNIT IIIs–2

In this unit are well drained, nearly level or gently sloping soils in the upland or on outwash plains. They are deep or moderately deep over loose sand and gravelly sand. They have a moderately coarse textured or coarse textured surface layer, a moderately coarse textured subsoil, and a coarse textured substratum. The content of organic matter is low or moderate. The available water capacity is low or moderate, and permeability is moderately rapid. Runoff is slow. The seasonal high water table is below 6 feet. Droughtiness is a limitation. Soil blowing is a hazard on soils with a coarse textured surface layer.

Corn, soybeans, and wheat and alfalfa, red clover, bromegrass, and orchardgrass for hay and pasture are the main crops. Early maturing crops are less affected by drought than are other crops. These soils are also well suited to wheat. Many vegetable crops and special crops are suited if irrigated.

The principal management needs are prevention of soil blowing, moisture conservation, and maintenance or improvement of organic-matter content and fertility. These soils are very friable and easy to work. They can be worked soon after rain without damaging soil tilth. Crop residue, cover crops, and minimum tillage help to control soil blowing and to maintain and improve the level of organic matter. Field windbreaks also help to control soil blowing.

CAPABILITY UNIT IIIs–12

The one soil in this unit, Chelsea fine sand, 6 to 12 percent slopes, is a deep, excessively drained, moderately sloping soil. It is dominantly coarse textured throughout the profile. The content of organic matter is low. The available water capacity is low, and permeability is rapid. Runoff is medium. The seasonal high water table is below 6 feet. Soil blowing is a hazard. Droughtiness is a serious limitation.

This soil is suited to fruit trees, vineyards, and Christmas trees. Alfalfa and bromegrass or orchardgrass are well suited for hay and pasture. Corn and soybeans can be grown, but yields are commonly low because of droughtiness. Wheat is suited to this soil. Row crops or special crops can be grown if irrigation is feasible.

The principal management needs are prevention of soil blowing and improvement of fertility and organic-matter content. This soil is loose and difficult to work when dry. Frequent applications of fertilizer are necessary because of rapid leaching of nutrients. Crop residue, cover crops, and minimum tillage help to control soil blowing and runoff and to maintain the level of organic matter.

CAPABILITY UNIT IVe–1

In this unit are deep, well drained, moderately slop-

ing or strongly sloping soils on uplands. They are eroded or severely eroded. They have a medium textured or moderately fine textured surface layer, a moderately fine textured subsoil, and a medium textured substratum. The content of organic matter is moderate or low. The available water capacity is high, and permeability is moderate. Runoff is rapid or very rapid. The seasonal high water table is below 6 feet. Water erosion is a severe hazard.

Corn, soybeans, wheat or oats, alfalfa, red clover, bromegrass, tall fescue, and orchardgrass are the main crops. Some areas are woodland. Row crops can be grown occasionally if erosion is controlled. These soils are best suited to hay and pasture.

The principal management needs are prevention of erosion and maintenance or improvement of tilth, organic-matter content, and fertility. The severely eroded soils are difficult to work because they are sticky when wet and hard and cloddy when dry. Conservation cropping systems in which row crops are grown only occasionally help to keep erosion to a minimum.

CAPABILITY UNIT IVe-5

The one soil in this unit, Riddles sandy loam, 12 to 18 percent slopes, eroded, is a deep, well drained, strongly sloping soil on uplands. It has a moderately coarse textured surface layer, a moderately fine textured subsoil, and a medium textured substratum. The content of organic matter is moderate. The available water capacity is high, and permeability is moderate. Runoff is very rapid. The seasonal high water table is below 6 feet. Erosion is a hazard. Droughtiness is a limitation for shallow-rooted crops during prolonged periods of low rainfall. It is not a limitation in included areas where the surface layer is medium textured. Slope is a limitation for the use of farm machinery.

This soil is well suited to permanent pasture or hay. Orchardgrass, tall fescue, bromegrass, red clover, and alfalfa are suitable for hay or pasture. Row crops or wheat or oats can be grown occasionally if erosion is controlled.

The principal management needs are prevention of erosion and improvement of organic-matter content and fertility. This soil has good tilth and is easy to work. Grassed waterways, contour farming, and minimum tillage help to control runoff and erosion. Otherwise, permanent vegetation helps to minimize surface runoff and erosion.

CAPABILITY UNIT IVe-6

In this unit are deep, well drained, moderately sloping or strongly sloping soils on uplands. They have a medium textured or moderately fine textured surface layer, a fine textured subsoil, and a moderately fine textured substratum. The content of organic matter is moderate, except in severely eroded areas, where it is low. The available water capacity is high, and permeability is slow. Runoff is rapid or very rapid. The seasonal high water table is below 6 feet. Erosion is a serious hazard. Slope is a limitation for the use of farm machinery.

These soils are well suited to permanent pasture or hay. Orchardgrass, tall fescue, bromegrass, alfalfa, and red clover are suitable for hay or pasture. If erosion is controlled, row crops and wheat or oats can be grown occasionally.

The principal management needs are prevention of erosion and improvement of organic-matter content, tilth, and fertility. These soils become hard and cloddy if worked or pastured when wet. If severely eroded, they are very sticky and plastic when wet and very hard and cloddy when dry. A conservation cropping system that includes grasses and legumes for forage most of the time is the most effective way to control runoff and erosion. Row crops can be grown occasionally to maintain good stands of grasses and legumes.

CAPABILITY UNIT IVe-18

In this unit are well drained, strongly sloping soils in the upland and on outwash plains. They are moderately deep over stratified, loose sand and gravelly sand. They have a coarse textured or moderately coarse textured surface layer, a moderately coarse textured or moderately fine textured subsoil, and a coarse textured substratum. The content of organic matter is low or moderate. The available water capacity is low or moderate, and permeability is moderate or moderately rapid. Runoff is medium to very rapid. The seasonal high water table is below 6 feet. Droughtiness is a limitation. Erosion and soil blowing are hazards. Slope is a limitation for the use of farm machinery.

These soils are well suited to hay and pasture. Alfalfa, red clover, bromegrass, and orchardgrass are suitable for hay and pasture. These soils are also well suited to woodland.

The principal management needs are prevention of erosion and soil blowing, moisture conservation, and improvement of organic-matter content and fertility. These soils are very friable and easy to work. A conservation cropping system where row crops are grown occasionally is best in controlling erosion and runoff. Cover crops, crop residue, minimum tillage, contour farming, and stripcropping also help to control erosion and runoff.

CAPABILITY UNIT IVw-3

In this unit are moderately deep or deep, very poorly drained, nearly level soils in depressions in the upland and on outwash plains. They have mixed organic material over mineral material at a depth of 21 to 50 inches. The underlying material is marl or coarse textured mineral material. The content of organic matter is very high. The available water capacity is high or very high, and permeability is rapid. Runoff is very slow. The seasonal high water table is at or near the surface. Some areas are ponded. Wetness is the main limitation. Soil blowing is a hazard.

These soils are suited to corn, soybeans, grasses, and many vegetable crops if drained. Corn and soybeans are the main crops. Special crops, such as onions, potatoes, carrots, and grass for sod, are also suited. Row crops can be grown year after year. Areas that are not completely drained are suited to reed canarygrass for pasture.

The principal management needs are maintaining drainage and controlling soil blowing. These soils have good tilth and are easy to work. Drainage permits more rapid oxidation and subsidence of the organic material.

Frost damage is a hazard in spring and fall. Fire is a hazard because the organic material burns readily during dry periods. Cover crops and crop residue help to control soil blowing early in winter and in spring. Shrub windbreaks are beneficial for this purpose throughout the year.

CAPABILITY UNIT Vw–8

In this unit are moderately deep and deep, very poorly drained, nearly level organic soils in undrained depressional areas in the upland and on outwash plains. The depth of the organic material ranges from 16 to 50 inches or more. Some soils are underlain by marl or sand and gravelly sand. The content of organic matter is very high. The available water capacity is high or very high, and permeability is moderate or moderately rapid. Runoff is very slow. Some areas are ponded. The seasonal high water table is at or near the surface most of the year. Wetness is a serious limitation.

Most areas are used for pasture or are in a natural vegetation of sedges, cattails, or water-tolerant trees and shrubs. Because most of these areas do not have outlets, drainage is often not feasible. Reed canarygrass for pasture is well suited. These soils provide habitat for wetland wildlife and some cover for other wildlife.

CAPABILITY UNIT VIe–1

In this unit are deep, well drained strongly sloping or steep soils on uplands. They have a medium textured or moderately fine textured surface layer, a moderately fine textured or fine textured subsoil, and a medium textured or moderately fine textured substratum. The content of organic matter is low or moderate, but in severely eroded areas it is low. The available water capacity is high, and permeability is moderate or slow. The seasonal high water table is below 6 feet. Runoff is very rapid. Erosion is a serious hazard. Slope is a limitation for the use of farm machinery.

These soils are well suited to permanent pasture or woodland. Orchardgrass, tall fescue, bromegrass, alfalfa, and red clover are suitable for hay or pasture. Grasses and legumes are difficult to establish in severely eroded areas, and forage yields are commonly low.

The principal management needs are prevention of erosion and improvement of tilth, organic-matter content, and fertility. The severely eroded soils are sticky and plastic when wet and become hard and cloddy when dry. Permanent grasses and legumes can be maintained by controlling grazing and by timely and adequate applications of lime and fertilizer. Renovating permanent pasture on the contour and establishing and maintaining grassed waterways help to control erosion and runoff.

CAPABILITY UNIT VIe–8

In this unit are moderately sloping to steep, well drained to somewhat excessively drained soils in the upland and on outwash plains. They are moderately deep or shallow over loose sand and gravelly sand. They have a moderately coarse textured or moderately fine textured surface layer, a moderately fine textured subsoil, and a coarse textured substratum. The content of organic matter is moderate or low. The available water capacity is moderate or low, and permeability is moderate. Runoff is very rapid. The seasonal high water table is below 6 feet. Droughtiness is a limitation, and erosion is a hazard. Slope is a limitation for the use of farm machinery.

Alfalfa, red clover, bromegrass, and orchardgrass are suitable for hay and pasture. This soil is also well suited to woodland.

The principal management needs are prevention of erosion, moisture conservation, and improvement of organic-matter and fertility. If not severely eroded, these soils are very friable and easy to work. If severely eroded, they are sticky when wet and hard and cloddy when dry. Contour farming, minimum tillage, and grassed waterways control erosion and reduce runoff. A conservation cropping system that includes row crops most of the time is also an effective way of controlling erosion. Crops can be grown occasionally to maintain good stands of grasses and legumes.

CAPABILITY UNIT VIw–1

This unit consists of a shallow or very shallow, very poorly drained, nearly level depressional Marl beds on uplands and outwash plains. These beds have less than 12 inches of organic or mineral material over alkaline and calcareous marl. The surface layer is mildly alkaline or moderately alkaline and in places contains many calcareous marl fragments (fig. 14). The content of organic matter is high or very high. The available water capacity is variable, and permeability ranges from slow to rapid. Runoff is very slow or ponded. The seasonal high water table is at or near the surface. Wetness is the main limitation.

Marl beds are suited to grasses for pasture and to special crops, such as onions, potatoes, and cabbage. Shallow-rooted crops are best suited. Most areas are used for pasture. Undrained areas are suitable for wetland wildlife habitat, and they provide some cover for other wildlife.

Draining and maintaining the supply of organic material in the surface layer are the principal management needs. These areas have good tilth and are easy to work. Open ditches can be used to drain the areas. Tile generally does not work well in the marl. Productivity depends on the thickness of the organic or mineral surface layer. Plowing up and mixing the marl with the surface layer should be avoided. A cover of permanent grass sod is beneficial.

Predicted yields

Table 2 shows the average yields per acre of the principal crops under high level management for the arable soils of the county.

The following are assumed to be part of high level management:

1. Using crop systems that maintain tilth and organic-matter content.
2. Controlling erosion to the maximum extent feasible to maintain or improve soil quality.
3. Maintaining a high level of fertility by use of fertilizer in accordance with frequent soil tests and recommendations of Purdue University Agricultural Experiment Station.

Figure 14.—Chunks of marl dug from Marl beds having shell fragments.

4. Liming the soils as indicated by soil tests.
5. Using crop residue to the fullest extent possible to protect and improve the soil.
6. Following minimum tillage where needed to minimize the hazards of compaction and erosion.
7. Using only the crop varieties that are best suited to the climate and the soil.
8. Controlling weeds carefully by tillage and spraying.
9. Draining wet areas so that wetness does not restrict yields.

The yields in table 2 are estimated averages for a period of 5 to 10 years. They are based on farm records; on interviews with farmers, members of the Purdue Agricultural Experiment Station, and area extension agents; and on direct observations of soil scientists and soil conservationists. The prevailing climate, the characteristics of the soils, and the influence of high level management on the soils were considered in making the estimates.

These yield figures are not intended to apply directly to specific tracts of land for any particular year, because the soils differ somewhat from place to place, management differs from farm to farm, and weather conditions vary from year to year. Nevertheless, these estimates appear to be as accurate a guide as can be obtained without detailed and lengthy investigation. They show the relative productivity of soils under high level management.

Woodland [2]

In table 3, most of the soils of Noble County have been assigned to woodland groups to assist owners in planning their use for wood crops. Each group is made up of soils that are suited to the same kinds of trees, that need approximately the same kind of management, and that have about the same potential productivity.

Each woodland group is identified by a three-part symbol, such as 1o1 or 3s17. The first part of the symbol, always a number, indicates the potential productivity of the soils in the group: 1 means very high; 2, high; 3, moderately high; 4, moderate; and 5, low. These ratings are based on field determination of average site index. Site index is the height in feet that the dominant trees of a given species, on a specified kind of soil, reach in a natural, unmanaged stand in a stated number of years. For the merchantable hardwoods and softwoods in this county, the site index is the height reached in 50 years.

The productivity ratings are based on field determination of average site index of an indicator forest type or species. Site indexes are grouped into site quality classes, and the classes are used to arrive at approximate expected yields per acre in cords and board feet. On the basis of research studies, site index can be converted into approximate expected growth and yield per acre in cords and board feet (*7*, *9*).

The second part of the symbol is a lowercase letter. This letter indicates an important soil property that imposes a slight to severe hazard or limitation in managing the soils of the group for wood crops. The letter *c* shows that the main limitation is the kind or amount of clay in the upper part of the soils in the group; *o* shows that the soils have few limitations that restrict their use for trees; *r* shows that the main limitation is steep slopes; *s* shows that the soils are sandy and dry, have little or no difference in texture between the surface layer and subsoil, have low available water capacity, and generally have a low supply of plant nutrients; *w* shows that water in or on the soil, either seasonally or all year, is the main limitation.

The third part of the symbol indicates a woodland group identification number. Identification numbers are generally assigned locally, but are part of a statewide system. All the units of the system are not represented in Noble County; therefore, the numbers in this soil survey are not consecutive.

In table 3, the soils are rated according to management limitations and hazards and the site index is listed for important trees. The most desirable species to favor in natural stands and species suitable for planting are also listed. Parr and Warsaw soils are not assigned to a woodland group because their native vegetation is grass. These soils, however, are suitable for white pine, Norway spruce, red pine, black walnut, and white ash.

[2] MITCHELL G. HASSLER, woodland conservationist, Soil Conservation Service, helped prepare this section.

TABLE 2.—*Predicted average yields per acre of principal crops*

[Dashes indicate that crop is not grown on specified soil or is not suited to it. Only arable soils are listed]

Soil	Corn	Soybeans	Wheat	Legume-grass hay	Pasture
	Bu	*Bu*	*Bu*	*Tons*	*A.U.M.*[1]
Adrian muck, drained	110	42	----	----	8.0
Aubbeenaubbee fine sandy loam	110	38	50	3.6	7.2
Blount silt loam, 0 to 2 percent slopes	105	37	47	3.4	6.8
Blount silt loam, 2 to 4 percent slopes, eroded	100	35	45	3.3	6.6
Boyer loamy sand, 2 to 6 percent slopes	70	26	38	2.5	5.0
Boyer loamy sand, 6 to 12 percent slopes	60	23	32	2.1	4.2
Boyer loamy sand, 12 to 18 percent slopes, eroded	50	18	25	1.6	3.2
Brady sandy loam	95	33	43	3.1	6.2
Brookston silt loam	145	51	65	4.8	9.6
Casco sandy clay loam, 8 to 15 percent slopes, severely eroded	----	----	20	1.3	2.6
Chelsea fine sand, 2 to 6 percent slopes	60	21	29	2.1	4.2
Chelsea fine sand, 6 to 12 percent slopes	50	17	25	1.8	3.6
Crosier loam, 0 to 2 percent slopes	120	42	52	4.0	8.0
Edwards muck, drained	100	38	----	----	7.2
Fox sandy loam, 0 to 2 percent slopes	85	30	42	2.8	5.6
Fox sandy loam, 2 to 6 percent slopes	85	30	42	2.8	5.6
Fox sandy loam, 6 to 12 percent slopes, eroded	70	24	35	2.3	4.6
Fox-Casco sandy loams, 12 to 18 percent slopes, eroded	55	19	28	1.8	3.6
Fox-Casco sandy loams, 18 to 25 percent slopes, eroded	----	----	20	1.3	2.6
Fulton silt loam	100	35	45	3.3	6.6
Gilford sandy loam	120	42	54	4.0	8.0
Haskins loam, 0 to 2 percent slopes	120	43	56	4.1	8.2
Homer loam	100	35	50	3.3	6.6
Houghton muck, drained	120	43	----	----	8.6
Martinsville fine sandy loam, 2 to 6 percent slopes	110	38	46	3.8	7.6
Metea loamy fine sand, 2 to 6 percent slopes	85	30	42	2.8	5.6
Miami loam, 2 to 6 percent slopes, eroded	105	37	47	3.4	6.8
Miami loam, 6 to 12 percent slopes, eroded	95	33	43	3.1	6.2
Miami loam, 12 to 18 percent slopes, eroded	80	28	36	2.6	5.2
Miami loam, 18 to 25 percent slopes, eroded	----	----	29	2.1	4.2
Miami clay loam, 6 to 12 percent slopes, severely eroded	80	28	36	2.5	5.0
Miami clay loam, 12 to 18 percent slopes, severely eroded	----	----	32	2.0	4.0
Miami loam, gravelly substratum, 0 to 2 percent slopes	115	38	50	3.6	7.2
Miami loam, gravelly substratum, 2 to 6 percent slopes, eroded	105	37	47	3.4	6.8
Milford silty clay loam	135	47	61	4.4	8.8
Morley silt loam, 2 to 6 percent slopes, eroded	90	32	40	3.0	6.0
Morley silt loam, 6 to 12 percent slopes, eroded	80	28	36	2.6	5.2
Morley silt loam, 12 to 18 percent slopes, eroded	65	23	29	2.1	4.2
Morley silty clay loam, 6 to 12 percent slopes, severely eroded	65	22	28	2.0	4.0
Morley silty clay loam, 12 to 18 percent slopes, severely eroded	----	----	25	1.8	3.6
Morley soils, 18 to 25 percent slopes	----	----	18	1.5	3.0
Morley, Miami, and Rawson loams, 6 to 12 percent slopes, eroded	95	34	43	3.1	6.2
Oshtemo loamy sand, 2 to 6 percent slopes	80	28	38	2.8	5.6
Oshtemo loamy sand, 6 to 12 percent slopes	70	24	34	2.5	5.0
Oshtemo sandy loam, 0 to 2 percent slopes	85	30	40	2.8	5.6
Palms muck, drained	120	45	----	----	8.8
Parr loam, 0 to 2 percent slopes	120	42	54	4.0	8.0
Pewamo silty clay loam	130	46	58	4.3	8.6
Rawson sandy loam, 2 to 6 percent slopes	105	38	44	3.6	7.2
Rawson sandy loam, 6 to 12 percent slopes, eroded	95	34	40	3.3	6.6
Rawson loam, 0 to 2 percent slopes	110	40	46	3.8	7.6
Rawson loam, 2 to 6 percent slopes	110	40	46	3.8	7.6
Rawson, Morley, and Miami loams, 2 to 6 percent slopes, eroded	110	40	46	3.8	7.6
Rensselaer loam	140	50	60	4.8	9.6
Riddles sandy loam, 0 to 2 percent slopes	110	38	46	3.8	7.6
Riddles sandy loam, 2 to 6 percent slopes	105	36	46	3.8	7.6
Riddles sandy loam, 6 to 12 percent slopes, eroded	95	34	40	3.3	6.6
Riddles sandy loam, 12 to 18 percent slopes, eroded	80	30	34	2.8	5.6
Sebewa loam	120	42	60	4.0	8.0
Shoals silt loam	130	46	52	4.3	8.6
Toledo silty clay loam	120	42	54	4.0	8.0
Wallkill silt loam	130	45	52	4.6	9.2
Warsaw loam, 0 to 2 percent slopes	90	31	45	3.0	6.0
Washtenaw silt loam	130	46	52	4.3	8.6
Whitaker loam	120	42	50	4.1	8.2

[1] A.U.M. stands for animal-unit-months, which is a term used to express the carrying capacity of pasture. It is the number of animals carried per acre multiplied by the number of months the pasture can be grazed during a single grazing season without injury to the sod. For example, an acre of pasture that provides 2 months of grazing for five cows has a carrying capacity of 10 animal-unit-months.

The hazards or limitations that affect management of soils for woodland are the hazard of windthrow, the hazard of erosion, equipment limitations, seedling mortality, and plant competition. Ratings applied to these hazards and limitations are expressed as *slight, moderate,* or *severe.* These ratings are explained in the following paragraphs.

Erosion hazard refers to the potential hazard of soil losses in woodland. The hazard is *slight* if expected soil losses are small; *moderate* if some soil losses are expected and care is needed during logging and construction to reduce soil losses; and *severe* if special methods of operation are necessary for preventing excessive soil losses. In Noble County, only the steep soils are subject to severe erosion.

Equipment limitations are rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting trees. In Noble County, soil characteristics having the most limiting effect are drainage, depth to the water table, slope, and texture of the surface layer. *Slight* indicates no restriction in the kind of equipment or in the time of year it is used; *moderate* means that use of equipment is restricted for less than 3 months of the year; and *severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Seedling mortality refers to the expected degree of mortality of planted seedlings as influenced by the kinds of soil when plant competition is not a limiting factor. Considered in the ratings are depth to the water table, the hazard of flooding, drainage, soil depth and structure, and degree of erosion. Normal rainfall, good planting stock, and proper planting are assumed. A rating of *slight* indicates an expected loss of less than 25 percent of the planted seedlings; *moderate,* 25 to 50 percent; and *severe,* more than 50 percent. Special preparation of the site is needed before planting for soils rated severe and for most soils rated moderate.

Windthrow hazard is rated according to the effect of the soil on root development and the ability of the soil to hold trees firmly. The hazard is *slight* if roots penetrate to a depth of more than 20 inches and trees withstand most winds; *moderate,* if roots penetrate 10 to 20 inches and some trees are blown down during periods of excessive soil wetness and strong wind; and *severe,* if roots penetrate 10 inches or less and trees can not withstand strong wind.

Plant competition is rated on the basis of the degree to which unwanted plants invade openings in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. A rating of *slight* means that competition from other plants is not a problem; *moderate,* that plant competition delays development of fully stocked stands of desirable trees; and *severe,* that plant competition prevents establishment of a desirable stand unless intensive site preparation and such practices as weeding are used to control undesirable plants.

Wildlife

This section provides information useful in planning, developing, and managing areas for wildlife. It rates the soils according to their potential for producing various kinds of wildlife habitat.

Soil suitability is one of the important factors for producing desired populations of wildlife. Other important factors, such as present land use, size and shape of areas, the pattern soils form with other soils on the landscape, and existing wildlife populations and their ability to move from place to place, require onsite investigation for their evaluation and are not considered in this section. Soil interpretations should be used along with other information in a comprehensive study of wildlife.

Proper manipulation of soil, water, and plants to produce suitable habitat is the most effective way to maintain and improve wildlife populations. Knowing the properties of soil makes it possible to predict how soils respond to management.

The relationships between kinds of soil and wildlife species are mostly indirect. Characteristics of soil affect the kinds of plants and water developments that make up wildlife habitat.

In table 4 each soil is rated for its suitability for the improvement, maintenance, or establishment of seven wildlife habitat elements. It is also rated for its suitability for three kinds of wildlife. The seven habitat elements are defined in the following paragraphs.

Grain and seed crops are domestic grains or seed-producing annual herbaceous plants planted to produce wildlife foods. Examples include corn, sorghum, wheat, oats, soybeans, millet, buckwheat, and sunflowers.

Domestic grasses and legumes are domestic perennial grasses and herbaceous legumes that are established by planting and furnish wildlife cover and food. Examples include fescue, brome, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, sericea lespedeza, and crownvetch.

Wild herbaceous plants are native or introduced perennial grasses and weeds that provide food and cover principally to upland forms of wildlife. They are mainly established through natural processes. Examples include nightshade, pigweed, knotweed, panicgrass, wild rye, ragweed, bristlegrass, goldenrod, and foxtailgrass.

Hardwood trees are deciduous trees, shrubs, and woody vines that produce fruits, nuts, buds, and twigs used extensively as food by wildlife. They are commonly established through natural processes, but also can be planted. Examples are oak, beech, cherry, hawthorne, dogwood, maple, birch, poplar, blueberry, greenbrier, rose, and viburnum.

Coniferous plants are cone-bearing trees and shrubs that are primarily of importance to wildlife as cover but also may furnish food in the form of browse, seeds, or fruitlike cones. They are commonly established through natural processes, but also can be planted. Examples are pine, spruce, white-cedar, hemlock, tamarack, redcedar, juniper, and yew.

Wetland plants are annual and perennial, wild herbaceous plants on moist to wet sites. They produce food or cover extensively used by wetland wildlife. Examples are smartweed, wild millet, bulrush, sedges, reeds, and cattails.

Shallow water areas are impoundments or areas excavated for control of water. They generally do not

TABLE 3.—

[Dashes indicate that no major wood crop is grown or measurement of existing trees is

Woodland groups	Potential productivity		Hazards and limitations	
	Species	Site index	Erosion hazard	Equipment limitation
Group 1o1. Deep, well drained or moderately well drained, nearly level to strongly sloping soils; high available water capacity. Martinsville: MdB. Miami: MfB2, MfC2, MfD2, MgC3, MgD3, MhA, MhB2. Morley: MrB2, MrC2, MrD2, MsC3, MsD3, MuC2. Rawson: RaB, RaC2, RbA, RbB, RdB2. Riddles: RsA, RsB, RsC2, RsD2.	Upland oak Tulip-poplar Sweetgum	85–95 90–105 73–78	Slight	Slight
Group 1r2. Deep, well drained, moderately steep soils; high available water capacity. Miami: MfE2. Morley: MtE.	Upland oak Tulip-poplar	85–95 95–105	Moderate	Moderate
Group 2o13. Deep, somewhat poorly drained, nearly level soil; high available water capacity; subject to flooding. Shoals: Sh.	Pin oak Sweetgum Tulip-poplar Virginia pine	85–95 80–90 85–95 85–95	Slight	Slight
Group 2o15. Well drained, nearly level to strongly sloping soils; moderately deep over sand and gravelly sand; moderate available water capacity. Fox: FoA, FoB, FoC2, FsD2. For Casco part of FsD2, see group 3s17.	Upland oak Tulip-poplar White pine Red pine	75–85 75–85 80–90 70–80	Slight	Slight
Group 2w11. Very poorly drained, nearly level soils; deep or moderately deep over sand and gravelly sand; high available water capacity in all but Sebewa soils, where it is moderate. Brookston: Bx. Milford: Mn. Pewamo: Pe. Rensselaer: Re. Sebewa: Se. Toledo: To. Washtenaw: Ws.	Pin oak Upland oak Sweetgum	80–90 70–80 85–95	Slight	Severe
Group 2r2. Shallow or moderately deep, well drained or somewhat excessively drained, moderately steep soils; moderate or low available water capacity. Fox: FsE2.	Upland oak Tulip-poplar White pine Red pine	75–85 75–85 80–90 70–80	Moderate or severe.	Moderate
Group 2s15. Deep, well drained, gently sloping soil; moderate available water capacity. Metea: MeB.	Upland oak Tulip-poplar White pine Red pine	75–85 75–85 80–90 70–80	Slight	Slight
Group 3o5. Deep, somewhat poorly drained, nearly level or gently sloping soils; high available water capacity. Aubbeenaubbee: Au. Blount: BlA, BlB2. Crosier: CrA. Fulton: Fu. Haskins: HaA. Whitaker: Wt.	Upland oak Pin oak Tulip-poplar Sweetgum	70–80 80–90 80–90 75–85	Slight	Slight
Group 3s17. Well drained to excessively drained, nearly level to strongly sloping soils; deep or moderately deep or shallow over sand and gravelly sand; low available water capacity in all but Oshtemo soils, where it is moderate. Boyer: BoB, BoC, BoD2. Casco: CcC3. Chelsea: ChB, ChC. Oshtemo: OsB, OsC, OtA.	Upland oak Red pine White pine Jack pine Aspen	65–75 75–80 80–90 65–75 75–80	Slight	Slight

Woodland

not feasible. No data for Lake borders, Marl beds, and Marsh. Properties too variable]

Hazards and limitations—Continued			Species to be favored—	
Seedling mortality	Windthrow hazard	Plant competition	In existing stands	For planting
Slight	Slight	Moderate	Red oak, white oak, white ash, tulip-poplar, black walnut, sugar maple.	White pine, red pine, black walnut, black locust, tulip-poplar, white ash.
Slight or moderate	Slight	Moderate	Red oak, white oak, white ash, tulip-poplar, black walnut, sugar maple.	White pine, red pine, black locust, black walnut, tulip-poplar.
Slight	Slight	Severe	Sweetgum, red maple, swamp chestnut oak, pin oak, tulip-poplar.	White pine, baldcypress, sycamore, red maple, white ash.
Slight	Slight	Moderate	Black oak, tulip-poplar, red oak, white oak, black walnut.	White pine, red pine, tulip-poplar, black walnut, European black alder.
Severe	Severe	Severe	Pin oak, red maple, bur oak, white ash, sweetgum.	White pine, baldcypress, Norway spruce, red maple, white ash, sweetgum.
Moderate	Slight	Moderate	Black oak, tulip-poplar, red oak, white oak, black walnut.	White pine, red pine, tulip-poplar, black walnut, European black alder.
Moderate	Slight	Moderate	Black oak, tulip-poplar, red oak, white oak, black walnut.	White pine, red pine, tulip-poplar, black walnut, European black alder.
Slight	Slight	Moderate	White ash, red maple, bur oak, pin oak, tulip-poplar, sweetgum.	White pine, baldcypress, white ash, red maple, tulip-poplar, sycamore.
Moderate	Slight	Slight	Black oak, white oak, black cherry.	White pine, red pine, jack pine.

TABLE 3.—

Woodland groups	Potential productivity		Hazards and limitations	
	Species	Site index	Erosion hazard	Equipment limitation
Group 3w20. Somewhat poorly drained, nearly level soils; deep or moderately deep over sand and gravelly sand; moderate available water capacity. Brady: Br. Homer: Hh.	Upland oak Pin oak White pine Aspen	65–75 85–95 65–75 80–90	Slight	Slight
Group 4w21. Deep, very poorly drained, nearly level soil; moderate available water capacity. Gilford: Gf.	Pin oak White pine Aspen	65–75 70–80 65–75	Slight	Severe
Group 4w23. Deep or moderately deep, very poorly drained, nearly level organic soils; high or very high available water capacity. Adrian: Ad, Am. Edwards: Ed, Em. Houghton: Hm, Ho. Palms: Pb. Wallkill: Wa.				

exceed 5 feet in depth. Examples are low dikes and levees, shallow dugouts, level ditches, devices for water-level control, and marshy streams and channels.

Soil characteristics that were evaluated to rate the soils for habitat elements are capability classification, thickness of soil useful to plants, surface texture, available water capacity, soil drainage, and flood hazard.

Ratings for the kinds of wildlife are based on ratings for wildlife habitat elements. They are made by weighing habitat elements according to their importance for the kind of wildlife. For example, grain and seed crops, domestic grasses and legumes, and wild herbaceous plants are given greater weight than hardwood trees as habitat elements for openland wildlife. The three kinds of wildlife are defined in the following paragraphs.

Openland wildlife are birds and mammals that normally frequent cultivated fields, pasture, meadows, lawns and areas overgrown with grasses, herbs, vines, and shrubs. Examples are quail, pheasant, cottontail rabbit, meadowlark, field sparrow, killdeer, red fox, and woodchuck (fig. 15).

Woodland wildlife are birds and mammals that normally frequent wooded areas of hardwood or coniferous trees and shrubs, or a mixture of both. Examples are woodcock, thrush, vireo, woodpecker, gray squirrel, fox squirrel, gray fox, raccoon, and white-tailed deer.

Wetland wildlife are birds and mammals that normally frequent wet areas such as streams, ponds, ditches, marsh, and swamps. Examples are ducks, geese, herons, shore birds, rails, kingfishers, mink, and muskrat.

The levels of suitability are expressed as good, fair, poor, and very poor. These ratings are defined in the following paragraphs.

Good.—Habitat is easily improved, maintained, or created. There are few or no soil limitations, and satisfactory results can be expected.

Fair.—Habitat can be improved, maintained, or created, but moderate soil limitations affect management. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

Poor.—Habitat can be improved, maintained, or created, but the soil limitations are severe. Management may be difficult and expensive and require intensive effort. Results are questionable.

Very poor.—Under the prevailing soil conditions, it is impractical to attempt to improve, maintain, or create habitat. Unsatisfactory results are probable.

The ratings of soils for wildlife habitat provide an aid in selecting sites for habitat management, an indication of management intensity needed to produce satisfactory results, and a means of grouping known soil conditions for broad-scale land-use planning for wildlife. The ratings, in conjunction with soil maps, identify places where management for desired wildlife is best applied and help in selecting suitable management. They also show why introducing a particular species of wildlife may not be feasible on a given site.

Engineering [3]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, shear strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth

[3] C. F. POLAND, engineer, Soil Conservation Service, helped prepare this section.

Woodland—Continued

Hazards and limitations—Continued			Species to be favored—	
Seedling mortality	Windthrow hazard	Plant competition	In existing stands	For planting
Slight	Slight	Moderate	Red maple, pin oak	White pine, European larch, red maple, sycamore.
Severe	Severe	Moderate	Pin oak, red maple, black ash	White pine, European larch, black spruce.
				Purple willow, arborvitae, white pine, bush-honeysuckle, multiflora rose.

Figure 15.—Gravel pit provides water for wildlife on Fox sandy loam, 6 to 12 percent slopes, eroded.

to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who—

TABLE 4.—

[No data for Lake borders.

Soil series and map symbols	Habitat elements			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees
Adrian:				
Ad	Very poor	Very poor	Very poor	Very poor
Am	Fair	Poor	Poor	Poor
Aubbeenaubbee: Au	Fair	Good	Good	Good
Blount:				
BlA	Fair	Good	Good	Good
BlB2	Fair	Good	Good	Good
Boyer:				
BoB	Poor	Fair	Good	Fair
BoC, BoD2	Poor	Fair	Good	Fair
Brady: Br	Fair	Good	Good	Good
Brookston: Bx	Fair[1]	Poor	Poor	Poor
Casco: CcC3	Poor	Poor	Fair	Fair
Chelsea: ChB, ChC	Poor	Poor	Fair	Poor
Crosier: CrA	Fair	Good	Good	Good
Edwards:				
Ed	Very poor	Very poor	Very poor	Very poor
Em	Fair	Poor	Poor	Poor
Fox:				
FoA, FoB	Good	Good	Good	Good
FoC2	Fair	Good	Good	Good
FsD2, FsE2	Poor	Fair	Good	Good
For Casco part of FsD2 and FsE2, see Casco series.				
Fulton: Fu	Fair	Good	Fair	Good
Gilford: Gf	Fair[1]	Poor	Poor	Poor
Haskins: HaA	Fair	Good	Good	Good
Homer: Hh	Fair	Good	Good	Good
Houghton:				
Hm	Very poor	Very poor	Very poor	Very poor
Ho	Fair	Poor	Poor	Poor
Marl beds: Ma	Very poor	Very poor	Poor	Poor
Marsh: Mb	Very poor	Very poor	Very poor	Very poor
Martinsville: MdB	Good	Good	Good	Good
Metea: MeB	Poor	Fair	Good	Good
Miami:				
MfB2, MhA, MhB2	Good	Good	Good	Good
MgC3, MfC2	Fair	Good	Good	Good
MfD2, MfE2, MgD3	Poor	Fair	Good	Good
Milford: Mn	Fair[1]	Poor	Poor	Poor
Morley:				
MrB2	Good	Good	Good	Good
MrC2, MsC3, MuC2	Fair	Good	Good	Good
For Miami and Rawson parts of MuC2, see Miami and Rawson series respectively.				
MrD2, MsD3, MtE	Poor	Fair	Good	Good

Wildlife habitat

Properties too variable]

Habitat elements—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Very poor	Good	Good	Very poor	Very poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.
Good	Fair	Fair	Good	Good	Fair.
Good	Poor	Very poor	Good	Good	Very poor.
Fair	Poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Poor	Good	Good	Poor	Poor	Good.
Fair	Very poor	Very poor	Poor	Fair	Very poor.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Fair	Fair	Good	Good	Fair.
Very poor	Good	Good	Very poor	Very poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Fair	Fair	Fair	Good	Fair.
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.
Good	Fair	Fair	Good	Good	Fair.
Very poor	Good	Good	Very poor	Very poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Poor	Good	Good	Very poor	Poor	Good.
Very poor	Good	Good	Very poor	Very poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.

TABLE 4.—

Soil series and map symbols	Habitat elements			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees
Oshtemo:				
OsB	Poor	Fair	Good	Good
OsC	Poor	Fair	Good	Good
OtA	Good	Good	Good	Good
Palms: Pb	Fair	Poor	Poor	Poor
Parr: PdA	Good	Good	Good	Good
Pewamo: Pe	Fair[1]	Poor	Poor	Poor
Rawson:				
RaB, RbA, RbB, RdB2	Good	Good	Good	Good
For Morley and Miami parts of RdB2, see Morley and Miami series respectively.				
RaC2	Fair	Good	Good	Good
Rensselaer: Re	Fair[1]	Poor	Poor	Poor
Riddles:				
RsA, RsB	Good	Good	Good	Good
RsC2	Fair	Good	Good	Good
RsD2	Poor	Fair	Good	Good
Sebewa: Se	Fair[1]	Poor	Poor	Poor
Shoals: Sh	Fair	Good	Fair	Good
Toledo: To	Fair[1]	Poor	Poor	Poor
Wallkill: Wa	Fair[1]	Poor	Poor	Poor
Warsaw: WrA	Fair	Good	Good	Good
Washtenaw: Ws	Fair[1]	Poor	Poor	Poor
Whitaker: Wt	Fair	Good	Good	Good

[1] This very poorly drained soil is assumed to be artificially drained. The rating is very poor if the soil is not drained.

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, clay, or marl.
4. Plan drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, and 7, which show, respectively, results of engineering tests on soil samples; estimates of soil properties significant in engineering; and interpretations of engineering properties.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 6 and 7, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths of more than 6 feet. Also, inspection of sites, especially small ones, is needed because many delineated areas of a given mapping unit can contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some terms used in this soil survey have special meanings in soil science that may not be familiar to engineers. The Glossary defines many of these terms.

Engineering classification systems

The two systems most commonly used in classifying soils for engineering are the Unified system (*2*), used by the SCS engineers, Department of Defense, and others and the AASHTO system, adopted by the Ameri-

Wildlife habitat—Continued

Habitat elements—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water areas	Openland	Woodland	Wetland
Good	Poor	Very poor	Fair	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Fair	Good	Fair.
Poor	Good	Good	Poor	Poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.

can Association of State Highway and Transportation Officials (*1*).

The Unified system is used to classify soils according to engineering uses for building material or for the support of structures other than highways. Soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes. There are eight classes of coarse-grained soils, which are divided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine-grained soils are divided on the basis of the plasticity index. Nonplastic classes are identified as ML, MH, OL, and OH and plastic classes as CL and CH. There is one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils, which have high bearing strength and are the best soils for subgrade, or foundation. At the other extreme, in group A–7, are clay soils, which have low strength when wet and are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 5. The estimated classification, without group index numbers, is given in table 6 for all soils mapped in the survey area.

Test data

Table 5 contains engineering test data for some of the major soil series in Noble County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based

TABLE 5.—*Engineering*

[Tests performed by Indiana State Highway Commission, Research and Training Center, West Lafayette, Indiana, in accordance

Soil name and location	Parent material	SCS report number BPR-S 73IN57—	Depth	Moisture-density [1]		Mechanical analysis [2]				
				Maximum dry density	Optimum moisture	Percentage passing sieve—				
						2 in	1½ in	1 in	¾ in	⅜ in
			In	*Lb per cu ft*	*Pct*					
Crosier loam: SW¼ sec. 32, T. 35 N., R. 10 E.	Glacial till (Wisconsin Age).	1–1	0–10	116	13				100	99
		1–4	22–35	113	16		100	99	99	97
		1–5	35–60	128	10				100	97
Fox sandy loam: NE¼NW¼ sec. 15, T. 35 N., R. 10 E.	Glacial outwash deposits.	3–1	0–9	122	11		100	99	96	91
		3–2	12–23	121	12			100	99	96
		3–3	35–60	122	11			100	98	94
Milford silty clay loam: SE¼ sec. 4, T. 34 N., R. 11 E.	Glacial lacustrine material (Wisconsin Age).	1–1	0–9	95	24					
		1–2	26–34	104	18					
		1–3	47–60	106	19					
Riddles sandy loam: NW corner sec. 16, T. 35 N., R. 9 E.	Glacial drift and the underlying glacial till.	2–1	0–9	112	15	100	92	92	89	89
		2–2	20–34	112	16			100	98	96
		2–3	52–72	128	10			100	99	98

[1] Based on AASHTO designation T 99–57, Method C (*1*).

[2] Mechanical analysis according to AASHTO designation T 88–57. Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including

TABLE 6.—*Estimates of soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The instructions for referring to other series that appear in the first column of

Soil series and map symbols	Depth to seasonal high water table	Potential frost action	Depth from surface	Dominant USDA texture	Classification
					Unified
	Feet		*Inches*		
Adrian: Ad, Am [1]	[2] 0–1	High	0–34	Muck (sapric)	Pt
			34–60	Sand and gravelly sand	SP, SW-SM
Aubbeenaubbee: Au	[4] 1–3	High	0–22	Fine sandy loam	SC or SM-SC
			22–41	Sandy clay loam	CL or SC
			41–60	Loam	SM-SC, SC, CL-ML, or CL
Blount: BlA, BlB2	[4] 1–3	High	0–9	Silt loam	CL-ML, or CL
			9–15	Heavy clay loam	CL
			15–25	Silty clay	CL or CH
			25–60	Clay loam	CL
Boyer: BoB, BoC, BoD2	> 6	Moderate	0–11	Loamy sand	SM or SW-SM
			11–32	Sandy loam	SM
			32–60	Sand and gravelly sand	SP, SP-SM
Brady: Br	1–3	Moderate	0–31	Sandy loam	SM or SM-SC
			31–53	Loamy sand	SM
			53–72	Sand and gravelly sand	SP or SP-SM
Brookston: Bx	[2] 0–1	High	0–13	Silt loam	CL
			13–44	Clay loam	CL
			44–60	Loam	CL
Casco: CcC3	> 6	Moderate	0–7	Sandy clay loam	SC
			7–18	Clay loam and sandy clay loam	SC
			18–60	Sand and gravelly sand	SP or GP
Chelsea: ChB, ChC	> 6	Low	0–65	Fine sand	SM or SW-SM

test data

with standard methods of testing, according to the American Association of State Highway and Transportation Officials (AASHTO)]

Mechanical analysis [2]—Continued												
Percentage passing sieve—Continued					Percentage smaller than—				Liquid limit	Plasticity index	Classification	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 60 (0.25 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO	Unified
									Pct			
98	96	92	81	53	42	9	7	3	22	3	A–4 (3)	ML
96	94	93	89	78	62	19	17	14	27	6	A–4 (8)	CL-ML
93	89	85	75	56	48	15	11	7	17	2	A–4 (3)	ML
87	83	78	58	34	14	1	2	0	15	[3]NP	A–2–4 (0)	SM-ML
92	84	74	51	26	22	15	14	13	24	8	A–2–4 (0)	SM-SC
84	64	39	16	4	3	2	1	1		NP	A–2–4 (0)	SW-SP
	100	97	94	84	77	61	38	25	43	13	A–7–5 (13)	ML, OL
	100	94	88	86	53	26	23	13	40	16	A–6 (10)	CL
100	99	95	91	86	60	32	29	25	41	21	A–7–6 (13)	CL
86	83	77	61	46	31	0	0	0	22	5	A–4 (2)	CL-ML
93	90	89	79	63	53	30	27	26	37	19	A–6 (9)	CL
93	87	83	76	68	48	6	2	0	16	3	A–4 (7)	ML

that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculation of grain-size fractions. The mechanical analysis data used in this table are not suitable for naming textural classes of soils.

[3] Nonplastic.

significant in engineering

soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the this table. The symbol > means greater than; the symbol < means less than]

Classification (Continued)	Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHTO	No. 10 (2.0 mm)	No. 40 (0.042 mm)	No. 200 (0.074 mm)						
				Percent		Inches per hour	Inches per inch of soil	pH	
					[3] NP	6.0–20	0.35–0.45	6.1–7.3	High.
A–1–b or A–3	60–80	35–55	0–10		NP	6.0–20	0.02–0.05	7.9–8.4	Low.
A–2–4 or A–4	80–95	60–75	30–40	20–30	5–10	6.0–20	0.16–0.18	5.6–6.5	Low.
A–6	90–95	70–85	35–55	25–35	10–15	0.6–2.0	0.16–0.18	5.6–6.5	Moderate.
A–4 or A–6	80–90	75–85	45–60	25–35	5–15	0.6–2.0	0.05–0.19	7.9–8.4	Low.
A–4 or A–6	95–100	85–100	80–90	25–35	5–15	0.6–2.0	0.22–0.24	6.6–7.3	Low.
A–6 or A–7	95–100	90–100	65–80	35–50	15–25	0.2–0.6	0.15–0.19	6.1–6.5	Moderate to high.
A–7	95–100	90–100	85–95	45–60	25–35	0.06–0.2	0.11–0.13	5.6–6.6	High.
A–6 or A–7	95–100	85–100	65–85	35–50	15–25	0.06–0.2	0.14–0.16	6.6–8.4	Moderate.
A–2–4, A–1–b	70–90	35–65	10–30		NP	6.0–20	0.10–0.12	6.1–6.5	Low.
A–2–4	70–85	40–60	20–35	15–25	NP–5	2.0–6.0	0.12–0.14	5.6–6.5	Low.
A–1–b	50–70	25–45	3–10		NP	> 20	0.02–0.04	7.9–8.4	Low.
A–2–4	80–90	45–65	25–35	15–25	NP–5	2.0–6.0	0.13–0.15	6.1–7.3	Low.
A–2–4 or A–1–b	80–90	40–65	10–30		NP	6.0–20	0.09–0.11	6.1–6.5	Low.
A–1–b	50–70	25–45	3–10		NP	> 20	0.02–0.04	6.1–6.5	Low.
A–6	95–100	90–100	70–90	25–35	10–20	0.6–2.0	0.22–0.24	6.6–7.3	Low.
A–6 or A–7	95–100	90–100	70–80	35–50	15–25	0.6–2.0	0.15–0.19	6.6–7.8	Moderate.
A–6	85–95	70–90	50–70	25–35	10–20	0.6–2.0	0.05–0.19	7.9–8.4	Low.
A 6 or A–2–6	80 90	65–80	30–50	25–35	10–15	0.6–2.0	0.18–0.20	6.1–6.5	Moderate.
A–6	75–90	65–85	35–50	25–35	10–25	0.6–2.0	0.16–0.18	6.6–7.3	Low.
A–1	40–60	20–40	0–5		NP	> 20	0.02–0.04	7.9–8.4	Low.
A–2–4	100	65–80	10–20		NP	6.0–20.0	0.05–0.07	5.1–6.5	Low.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Potential frost action	Depth from surface	Dominant USDA texture	Classification: Unified
	Feet		*Inches*		
Crosier: CrA	[4] 1–3	High	0–10	Loam	CL
			10–35	Clay loam	CL
			35–60	Loam	CL or SC
Edwards: Ed, Em [1]	[3] 0–1	High	0–29	Muck (sapric)	Pt
			29–60	Marl	
*Fox: FoA, FoB, FoC2, FsD2, FsE2 For Casco part of FsD2 and FsE2, see Casco series.	> 6	Moderate	0–14	Sandy loam	SM or SM-SC
			14–35	Sandy clay loam and clay loam	SC or CL
			35–60	Sand and gravelly sand	SP, SP-SM, or GP-GM
Fulton: Fu	[4] 1–3	Moderate	0–11	Silt loam	ML, CL-ML, or CL
			11–39	Silty clay	CH or CL
			39–60	Silty clay	CH or CL
Gilford: Gf	[3] 0–1	High	0–12	Sandy loam	SC or SM-SC
			12–40	Sandy loam	SC or SM-SC
			40–60	Sand and gravelly sand	SP or SP-SM
Haskins: HaA	[4] 1–3	High	0–11	Loam	CL
			11–37	Light clay loam and light silty clay loam.	CL
			37–41	Silty clay	CL or CH
			41–60	Silty clay	CL or CH
Homer: Hh	1–3	High	0–18	Loam	CL
			18–34	Sandy clay loam and gravelly sandy clay loam.	SC
			34–60	Sand and gravelly sand	SP, SP-SM, or GP-GM
Houghton: Hm, Ho [1]	[3] 0–1	High	0–60	Muck (sapric)	Pt
Lake borders: La. No estimates. Material too variable.					
Marl beds: Ma [1]	[3] 0–1	High	0–10	Mucky loam	ML or OL
			10–60	Marl	
Marsh: Mb. No estimates. Material too variable.					
Martinsville: MdB	> 6	Moderate	0–18	Fine sandy loam	SC or SM-SC
			18–44	Sandy clay loam	SC or CL
			44–60	Stratified sandy loam, fine sand, silt, and silt loam.	SM, SM-SC, SC, ML, CL-ML, or CL
Metea: MeB	> 6	Moderate	0–37	Loamy fine sand	SM
			37–48	Clay loam	CL
			48–60	Loam	CL
Miami: MfB2, MfC2, MfD2, MfE2	> 6	Moderate	0–11	Loam	CL
			11–38	Clay loam	CL
			38–60	Loam	CL or SC
MgC3, MgD3	> 6	Moderate	0–6	Clay loam	CL or ML
			6–21	Clay loam and heavy loam	CL or ML
			21–60	Loam	CL or SC
MhA, MhB2	> 6	Moderate	0–12	Loam	CL
			12–39	Clay loam	CL
			39–48	Loam	CL or SC
			48–60	Sand and gravelly sand	SP, SP-SM

significant in engineering—Continued

Classification (Continued)	Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHTO	No. 10 (2.0 mm)	No. 40 (0.042 mm)	No. 200 (0.074 mm)						
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	
A–6	95–100	85–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–6 or A–7	85–95	80–90	60–70	35–50	15–25	0.2–0.6	0.15–0.19	5.6–6.5	Moderate.
A–6	80–95	70–90	45–70	25–35	10–20	0.2–2.0	0.05–0.19	7.9–8.4	Low.
					NP	6.0–20.0	0.35–0.45	6.6–7.8	High.
	95–100	80–90	60–80		NP	Variable	Variable	7.9–8.4	Moderate.
A–2–4 or A–4	80–90	45–65	25–40	15–25	NP–5	2.0–6.0	0.13–0.15	6.1–6.5	Low.
A–6	85–95	75–95	35–55	25–35	15–25	0.6–2.0	0.16–0.18	5.6–7.3	Low.
A–1	40–60	20–45	0–10		NP	> 20	0.02–0.04	7.9–8.4	Low.
A–4 or A–6	100	90–100	70–90	25–35	5–15	0.6–2.0	0.22–0.24	6.1–6.5	Low.
A–7	100	95–100	90–95	45–60	25–35	< 0.2	0.11–0.13	5.6–7.3	High.
A–7	100	95–100	90–95	45–60	25–35	< 0.2	0.10–0.12	7.9–8.4	High.
A–2–4 or A–4	95–100	60–70	25–40	20–30	5–10	2.0–6.0	0.13–0.15	6.1–6.5	Low.
A–2–4	90–100	55–70	25–35	20–30	5–10	2.0–6.0	0.12–0.14	6.1–7.3	Low.
A–1–b or A–3	80–95	40–65	3–10		NP	> 20	0.03–0.06	7.9–8.4	Low.
A–6	95–100	85–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–6 or A–7	90–100	80–100	55–80	35–50	15–25	0.6–2.0	0.17–0.19	5.6–6.5	Moderate.
A–7	95–100	90–100	80–95	45–60	25–35	< 0.2	0.11–0.13	6.6–7.3	High.
A–7	95–100	90–100	80–95	45–60	25–35	< 0.2	0.10–0.12	7.9–8.4	High.
A–6	75–90	65–85	55–65	25–35	10–20	0.6–2.0	0.20–0.22	5.6–7.3	Low.
A–1–b, A–2–6, or A–6	60–80	45–75	20–45	25–35	10–15	0.6–2.0	0.16–0.18	5.6–6.0	Low.
A–1	40–60	20–40	3–10		NP	> 20	0.02–0.04	7.4–8.4	Low.
					NP	6.0–20.0	0.35–0.45	5.6–6.5	High.
					NP	2.0–6.0	0.22–0.25	7.4–7.8	Moderate.
					NP	Variable	Variable	7.8–8.4	Moderate.
A–4	95–100	65–85	35–50	20–30	5–10	2.0–6.0	0.16–0.18	5.6–6.5	Low.
A–6	90–100	70–90	35–55	25–35	10–15	0.6–2.0	0.16–0.18	5.6–7.3	Moderate.
A–4	90–100	60–80	40–60	5–20	NP–10	2.0–6.0	0.19–0.21	7.9–8.4	Low.
A–2–4	95–100	70–85	20–35		NP	> 20	0.10–0.12	5.6–6.0	Low.
A–6 or A–7	95–100	85–100	65–80	35–50	15–25	0.6–2.0	0.15–0.19	6.1–7.3	Moderate.
A–6	80–90	70–80	45–65	25–35	10–20	0.6–2.0	0.05–0.19	7.9–8.4	Low.
A–6	95–100	80–95	55–75	25–35	10–20	0.6–2.0	0.20–0.22	6.1–7.3	Low.
A–6 or A–7	95–100	85–95	65–80	35–50	15–25	0.6–2.0	0.15–0.19	5.6–7.8	Moderate.
A–6	85–95	70–90	45–65	15–30	10–20	0.2–2.0	0.05–0.19	7.9–8.4	Low.
A–6 or A–7	95–100	85–95	65–80	35–50	15–25	0.6–2.0	0.17–0.19	6.1–7.3	Moderate.
A–6 or A–7	95–100	80–90	65–80	35–50	15–25	0.6–2.0	0.15–0.19	5.6–7.8	Moderate.
A–6	85–95	70–90	45–65	15–30	10–20	0.2–2.0	0.05–0.19	7.9–8.4	Low.
A–6	95–100	80–95	55–75	25–35	10–20	0.6–2.0	0.20–0.22	6.1–7.3	Low.
A–6 or A–7	95–100	85–95	65–80	35–50	15–25	0.6–2.0	0.15–0.19	5.1–7.3	Moderate.
A–6	85–95	70–90	45–65	15–30	10–20	0.2–2.0	0.05–0.19	7.4–7.8	Low.
A–1	40–60	20–45	2–10		NP	> 20	0.02–0.04	7.9–8.4	Low.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Potential frost action	Depth from surface	Dominant USDA texture	Classification
					Unified
	Feet		*Inches*		
Milford: Mn	[2] 0–1	High	0–16	Silty clay loam	CL
			16–49	Silty clay	CH or CL
			49–63	Silty clay loam with thin strata of silt loam, sandy loam, and silty clay.	CL
*Morley:					
MrB2, MrC2, MrD2, MuC2	3–6 or > 6	Moderate	0–9	Silt loam	ML, CL-ML, or CL
			9–30	Clay	CH
			30–60	Clay loam	CL
For Miami and Rawson parts of MuC2, see Miami and Rawson series respectively.					
MsC3, MsD3, MtE	3–6 or > 6	Moderate	0–7	Silty clay loam	CL
			7–26	Silty clay	CH or CL
			26–60	Clay loam	CL
Oshtemo:					
OsB, OsC	> 6	Moderate	0–18	Loamy sand	SM
			18–26	Sandy loam	SM or SM-SC
			26–53	Loamy sand	SM
			53–60	Sand and gravelly sand	SP or SP-SM
OtA	> 6	Moderate	0–12	Sandy loam	SM or SM-SC
			12–46	Sandy loam	SM or SM-SC
			46–60	Sand and gravelly sand	SP or SP-SM
Palms: Pb [1]	[2] 0–1	High	0–27	Muck (sapric)	Pt
			27–60	Stratified sandy loam, loam, silty clay loam, and clay loam.	SC or CL
Parr: PdA	> 6	Moderate	0–12	Loam	CL
			12–36	Clay loam	CL
			36–90	Loam	CL
			90–110	Sand and gravelly sand	SP or SP-SM
Pewamo: Pe	[2] 0–1	High	0–14	Silty clay loam	CL
			14–48	Heavy silty clay loam and silty clay.	CH or CL
			48–60	Silty clay loam	CL
*Rawson:					
RaB, RaC2	3–6 or > 6	Moderate	0–13	Sandy loam	SC or SM-SC
			13–30	Sandy clay loam and loam	SC or CL
			30–41	Silty clay and heavy clay loam.	CL or CH
			41–60	Clay loam	CL
RbA, RbB, RdB2	3–6 or > 6	Moderate	0–14	Loam	CL
			14–32	Clay loam	CL
			32–40	Clay	CH
			40–60	Clay loam	CL
For Morley and Miami parts of RdB2, see Morley and Miami series respectively.					
Rensselaer: Re	[2] 0–1	High	0–13	Loam	CL
			13–42	Clay loam	CL
			42–60	Stratified fine sand, sandy loam, and silt.	CL, CL-ML, SC, or SM-SC
Riddles: RsA, RsB, RsC2, RsD2	> 6	Moderate	0–14	Sandy loam	SC or SM-SC
			14–52	Clay loam	CL
			52–72	Loam	CL or SC
Sebewa: Se	[2] 0–1	High	0–12	Loam	CL
			12–38	Sandy clay loam	SC
			38–60	Sandy and gravelly sand	SP or SP-SM
Shoals: Sh	1–3	High	0–39	Silt loam and loam	CL-ML or CL
			39–60	Stratified loam, silt loam, light clay loam, and sandy loam.	CL, CL-ML, SM-SC, or SC

significant in engineering—Continued

Classification (Continued)	Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHTO	No. 10 (2.0 mm)	No. 40 (0.042 mm)	No. 200 (0.074 mm)						
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	
A–6 or A–7	95–100	90–100	80–95	35–50	20–30	0.6–2.0	0.21–0.23	6.6–7.3	Moderate.
A–7	95–100	90–100	85–95	45–60	25–35	0.2–0.6	0.11–0.13	6.6–7.3	High.
A–6 or A–7	95–100	85–100	50–80	35–50	20–30	0.2–0.6	0.16–0.18	7.4–7.8	Moderate.
A–4 or A–6	95–100	85–100	65–90	25–35	5–15	0.6–2.0	0.22–0.24	6.6–7.3	Low
A–7	95–100	85–100	75–95	50–70	30–45	0.06–0.2	0.09–0.11	5.6–6.5	Moderate.
A–6 or A–7	95–100	85–100	65–80	35–50	15–25	0.2–0.6	0.14–0.16	7.4–8.4	Moderate.
A–6 or A–7	95–100	90–100	80–95	35–50	20–30	0.2–0.6	0.21–0.23	6.1–7.3	Moderate.
A–7	95–100	90–100	85–95	45–60	25–40	0.06–0.2	0.11–0.13	5.6–6.5	Moderate.
A–6 or A–7	95–100	85–100	65–80	35–50	15–25	0.2–0.6	0.14–0.16	7.4–8.4	Moderate.
A–2–4 or A–1–b	80–95	40–70	12–30		NP	2.0–6.0	0.10–0.12	6.1–6.5	Low.
A–2–4	80–90	45–65	25–35	10–20	NP–5	2.0–6.0	0.12–0.14	5.1–6.0	Low.
A–2–4 or A–1–b	80–90	40–65	12–30		NP	6.0–20	0.09–0.11	5.1–7.3	Low.
A–1–b	50–70	25–50	3–10		NP	> 20	0.02–0.04	7.9–8.4	Low.
A–2–4	85–95	50–65	25–35	10–20	NP–5	2.0–6.0	0.13–0.15	5.6–6.5	Low.
A–2–4	80–90	45–65	25–35	10–20	NP–5	2.0–6.0	0.12–0.14	5.1–6.0	Low.
A–1–b	50–70	25–50	3–10		NP	> 20	0.02–0.04	7.9–8.4	Low.
					NP	6.0–20	0.35–0.45	6.6–7.3	High.
A–2, A–6, or A–7	85–95	55–90	30–75	20–50	10–30	0.6–2.0	0.17–0.19	7.4–8.4	Low or moderate.
A–6	95–100	80–95	55–75	25–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–6 or A–7	85–95	75–95	60–75	35–50	15–25	0.6–2.0	0.15–0.19	5.6–7.3	Moderate.
A–6	85–95	70–90	50–70	25–35	10–20	0.6–2.0	0.05–0.19	7.9–8.4	Low.
A–1	40–60	20–45	2–10		NP	0.6–2.0	0.02–0.04	7.9–8.4	Low.
A–6 or A–7	95–100	90–100	80–90	35–50	20–30	0.2–0.6	0.21–0.23	6.6–7.3	Moderate.
A–7	95–100	90–100	85–95	40–55	20–35	0.2–0.6	0.11–0.20	6.6–7.3	High.
A–6 or A–7	95–100	90–100	80–90	35–50	20–30	0.2–0.6	0.18–0.20	7.9–8.4	Moderate.
A–2–4 or A–4	85–95	50–65	25–40	10–20	5–10	2.0–6.0	0.13–0.15	6.1–7.3	Low.
A–6	85–100	65–90	40–70	25–35	10–15	0.6–2.0	0.16–0.18	5.1–6.5	Moderate.
A–7	95–100	85–100	80–95	45–60	25–35	< 0.2	0.12–0.15	5.6–6.5	Moderate or high.
A–6 or A–7	95–100	85–100	65–80	35–50	15–25	0.2–0.6	0.14–0.16	7.9–8.4	Moderate.
A–6	95–100	80–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	5.6–6.5	Low.
A–6 or A–7	90–100	80–100	60–80	35–50	15–25	0.6–2.0	0.15–0.19	5.6–6.5	Moderate.
A–7	95–100	85–100	85–95	50–70	30–45	< 0.2	0.09–0.11	6.1–7.3	High.
A–6 or A–7	95–100	85–100	65–80	35–50	15–25	0.2–0.6	0.14–0.16	7.9–8.4	Moderate.
A–6	98–100	85–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–6 or A–7	98–100	90–100	70–80	35–45	15–25	0.06–0.2	0.15–0.19	6.6–7.3	Moderate.
A–4	98–100	75–85	40–60	<30	5–10	2.0–6.0	0.19–0.21	7.9–8.4	Low.
A–2–6	85–95	50–65	25–35	10–20	5–10	2.0–6.0	0.13–0.15	6.1–6.5	Low.
A–6 or A–7	80–95	70–95	55–75	35–50	15–25	0.6–2.0	0.15–0.19	5.6–7.3	Moderate.
A–6	80–90	65–85	45–65	25–35	10–20	0.6–2.0	0.05–0.19	7.9–8.4	Low.
A–6	95–100	80–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–2 or A–6	75–90	60–85	25–50	25–35	10–15	0.6–2.0	0.16–0.18	6.5–7.8	Low.
A–1–b	50–70	25–50	2–12		NP	> 20	0.03–0.05	7.9–8.4	Low.
A–4 or A–6	100	85–100	60–90	25–35	5–15	0.6–2.0	0.22–0.24	6.6–7.3	Low.
A–4 or A–6	90–100	60–90	35–70	25–40	5–15	0.6–2.0	0.18–0.20	7.4–7.8	Low.

TABLE 6.—*Estimates of soil properties*

Soil series and map symbols	Depth to seasonal high water table	Potential frost action	Depth from surface	Dominant USDA texture	Classification: Unified
	Feet		*Inches*		
Toledo: To	[2] 0–1	High	0–8	Silty clay loam	CL
			8–44	Silty clay	CH or CL
			44–60	Silty clay	CH or CL
Wallkill: Wa [1]	[2] 0–1	High	0–27	Silt loam	CL-ML or CL
			27–60	Muck (sapric)	Pt
Warsaw: WrA	>6	Moderate	0–14	Loam	CL
			14–35	Sandy clay loam	SC
			35–60	Sand and gravelly sand	GP, GP-GM, SP, or SP-SM
Washtenaw: Ws	[2] 0–1	High	0–39	Silt loam	CL-ML or CL
			39–48	Silty clay loam	CL
			48–60	Silty clay	CL or CH
Whitaker: Wt	1–3	High	0–9	Loam	CL
			9–38	Clay loam	CL
			38–60	Stratified silt loam, sandy loam, and fine sand.	SM, SM-SC, SC, ML, CL-ML, or CL

[1] Some estimates are not made for horizons that are mainly organic matter or marl.
[2] Ponded.

TABLE 7.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. the instructions for referring to other series

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Adrian: Ad, Am	Poor: organic material oxidizes rapidly; erodible.	Good for sand; fair for gravel.	Poor: organic material over sand and gravelly sand; very poorly drained; poor compaction; high frost action potential; high shrink-swell in organic material.	Organic material not suitable; high compressibility; high permeability; unstable.
Aubbeenaubbee: Au	Good	Unsuited	Fair: somewhat poorly drained; fair compaction; high frost action potential; low or moderate shrink-swell.	Subsoil: fair to good compaction; medium susceptibility to piping; medium to low permeability when compacted. Substratum: fair to poor compaction; medium compressibility; medium to low shear strength; medium to low permeability when compacted.
Blount: BlA, BlB2	Fair: suitable material is somewhat thin; clayey subsoil.	Unsuited	Poor: somewhat poorly drained; fair compaction; high frost action potential; moderate or high shrink-swell.	Subsoil: fair to poor compaction; medium to low shear strength; high compressibility; low permeability when compacted. Substratum: fair to good compaction; medium to low shear strength; low permeability when compacted.

significant in engineering—Continued

Classification (Continued)	Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential
AASHTO	No. 10 (2.0 mm)	No. 40 (0.042 mm)	No. 200 (0.074 mm)						
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*	
A–6 or A–7	100	95–100	85–95	35–50	20–30	0.2–0.6	0.21–0.23	6.6–7.3	Moderate.
A–7	100	95–100	90–95	45–60	25–40	0.06–0.2	0.11–0.13	6.6–7.8	High.
A–7	100	95–100	90–95	45–60	25–40	0.06–0.2	0.10–0.12	7.9–8.4	High.
A–4 or A–6	95–100	90–100	70–90	25–35	5–15	0.6–2.0	0.22–0.24	6.6–7.3	Low.
					NP	6.0–20	0.35–0.45	6.1–6.5	High.
A–6	90–100	75–95	55–75	25–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–6 or A–2–6	65–80	50–75	25–45	25–35	10–15	0.6–2.0	0.16–0.18	5.6–7.3	Low.
A–1–a or A–3	30–55	15–30	2–10		NP	> 20	0.02–0.04	7.9–8.4	Low.
A–4 or A–6	95–100	90–100	70–90	25–35	5–15	0.6–2.0	0.22–0.24	6.6–7.3	Low.
A–6 or A–7	95–100	90–100	80–95	35–50	20–30	0.06–0.2	0.18–0.20	6.6–7.3	Moderate.
A–6 or A–7	95–100	90–100	85–95	45–65	25–40	0.06–0.6	0.10–0.12	6.6–7.3	High.
A–6	95–100	80–95	55–75	20–35	10–20	0.6–2.0	0.20–0.22	6.6–7.3	Low.
A–6 or A–7	90–100	80–100	65–80	35–50	15–25	0.6–2.0	0.15–0.19	6.1–7.3	Moderate.
A–4	90–100	60–90	40–80	5–20	NP–10	0.6–2.0	0.19–0.21	7.9–8.4	Low.

[3] Nonplastic.
[4] Perched water table.

engineering properties

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully that appear in the first column of this table]

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Rapid seepage; high water table; suitable for pit type ponds; rapid recharge.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; rapid permeability; subsidence of muck is a problem; outlets not available in most depressional areas.	Not needed; nearly level in depressions; runoff very slow or ponded; organic material.	Generally not needed; high water table; wetness; runoff very slow or ponded.
Rapid seepage in upper part; medium seepage in lower subsoil and substratum; seasonal high water table.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability in lower subsoil.	Needed only to divert runoff from adjoining higher areas; nearly level; slow runoff.	Soil features favorable; needed only where a concentrated flow of water runs in from adjoining higher areas.
Slow seepage; seasonal high water table.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; slow permeability.	Needed in nearly level areas only to divert runoff from adjoining higher areas. In gently sloping areas: clayey subsoil; medium runoff; short, undulating slopes.	Clayey subsoil; difficult to vegetate; seasonal high water table; seepage on slopes.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Boyer: BoB, BoC, BoD2	Poor: too sandy; droughty material; hazard of soil blowing.	Good for sand; fair for gravel.	Fair: good compaction characteristics; low shrink-swell; moderate frost action potential.	Subsoil: fair to good compaction characteristics; medium to high susceptibility to piping; medium to low permeability when compacted. Substratum: good compaction characteristics; medium or high shear strength; low compressibility; high permeability when compacted.
Brady: Br	Good	Good for sand; fair for gravel.	Fair: somewhat poorly drained; fair to good compaction characteristics; low shrink-swell; high frost action potential.	Subsoil; fair to good compaction characteristics; medium to high susceptibility to piping; medium to low permeability when compacted. Substratum: good compaction characteristics; low compressibility; high permeability when compacted; medium to high susceptibility to piping.
Brookston: Bx	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; fair compaction characteristics; high frost action potential; low or moderate shrink-swell.	Subsoil; fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair compaction characteristics; medium to low shear strength; medium or low permeability when compacted.
Casco: CcC3	Poor: shallow, droughty soil; somewhat clayey; many pebbles.	Good	Good: good compaction characteristics; moderate frost action potential in subsoil; low shrink-swell and frost action potential in substratum.	Subsoil: good to fair compaction characteristics; low to medium compressibility; low permeability when compacted. Substratum: good compaction characteristics; high shear strength; low compressibility; high permeability when compacted.
Chelsea: ChB, ChC	Poor: too sandy; droughty; hazard of soil blowing.	Fair for fine sand; no gravel.	Good: good compaction characteristics; low frost action potential and shrink-swell.	Good compaction characteristics; low compressibility; medium to high susceptibility to piping; high permeability when compacted.
Crosier: CrA	Fair: suitable material is somewhat thin; somewhat clayey subsoil.	Unsuited	Poor: somewhat poorly drained; fair to poor compaction characteristics; moderate or low shrink-swell; high frost action potential.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair to poor compaction characteristics; medium to low shear strength; medium or low permeability when compacted.
Edwards: Ed, Em	Poor: organic material oxidizes rapidly; erodible.	Unsuited	Poor: organic material over marl; very poorly drained; poor compaction characteristics; high frost action potential; high shrink-swell in muck.	Organic material not suitable; high compressibility; high permeability; unstable.

engineering properties—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Rapid seepage in substratum; deep water table; pond size may be restricted in moderately sloping and strongly sloping areas.	Not needed; well drained	Erodible; complex slopes with potholes; moderately rapid permeability; droughty; hazard of soil blowing.	Droughty; difficult to establish and maintain vegetation; erodible.
Rapid seepage in substratum; seasonal high water table.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderately rapid permeability; sandy material requires special attention.	Generally not needed; nearly level; slow runoff.	Soil features favorable; needed only where concentrated flow of water runs in from adjoining higher areas.
Slow seepage; high water table; suitable for pit type ponds; slow recharge.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; moderate permeability.	Needed only to divert runoff from adjoining higher areas. In depressions: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Rapid seepage in substratum; deep water table; slope may restrict pond size.	Not needed; well drained to somewhat excessively drained.	Complex, short slopes with potholes; sand and gravelly sand at a depth of less than 2 feet; very droughty; difficult to vegetate in cuts.	Sand and gravelly sand at a depth of less than 2 feet; droughty; difficult to vegetate in cuts; complex, short slopes with potholes.
Rapid seepage; deep water table; slope may restrict pond size.	Not needed; excessively drained; rapid permeability.	Sandy; slow or medium runoff; very droughty; difficult to vegetate; subject to soil blowing.	Sandy; slow or medium runoff; difficult to vegetate; hazard of soil blowing; droughty.
Medium seepage; seasonal high water table.	Somewhat poorly drained; high water table at a depth of 1 foot to 3 feet; moderately slow permeability.	Needed only to divert runoff from higher adjoining areas. In nearly level areas: slow runoff.	Soil features favorable; needed only where a concentrated flow of water runs in from higher adjoining areas.
Rapid seepage in muck; variable seepage in marl; high water table; suitable for pit type ponds; organic material and marl unstable.	Very poorly drained; seasonal high water table at surface or within 1 foot; moderately rapid permeability in muck; variable permeability in marl substratum; subsidence of muck is a problem; outlets often not available.	Not needed; nearly level in depressions; very slow runoff or ponded; organic material over marl.	Generally not needed; high water table; wetness; very slow runoff or ponded.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
*Fox: FoA, FoB, FoC2, FsD2, FsE2. For Casco part of FsD2 and FsE2, see Casco series.	Fair where slopes are 0 to 12 percent: borrow area difficult to vegetate. Poor where slopes are more than 12 percent; many pebbles; borrow area difficult to vegetate.	Good	Fair: good compaction characteristics; moderate frost action potential; low shrink-swell.	Subsoil: good to fair compaction characteristics; low to medium compressibility; low permeability when compacted. Substratum: good compaction characteristics; high shear strength; low compressibility; high permeability when compacted.
Fulton: Fu	Fair: suitable material is somewhat thin; very clayey subsoil.	Unsuited	Poor: clayey material; somewhat poorly drained; fair to poor compaction characteristics; moderate frost action potential; high shrink-swell.	Fair to poor compaction characteristics; medium to low shear strength; high compressibility; low permeability when compacted.
Gilford: Gf	Poor: very poorly drained.	Good for sand; small amount of gravel.	Poor: very poorly drained; fair to good compaction characteristics; high frost action potential; low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to high susceptibility to piping; medium to low permeability when compacted. Substratum: good compaction characteristics; low compressibility; high permeability when compacted; medium to high susceptibility to piping.
Haskins: HaA	Fair: suitable material is somewhat thin; somewhat clayey subsoil.	Unsuited	Poor: somewhat poorly drained; fair to poor compaction characteristics; high frost action potential; moderate or high shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair to poor compaction characteristics; medium to low shear strength; high compressibility; low permeability when compacted.
Homer: Hh	Fair: borrow area difficult to vegetate.	Good	Poor: somewhat poorly drained; good compaction characteristics; high frost action potential; low shrink-swell.	Subsoil: good to fair compaction characteristics; low to medium compressibility; low permeability when compacted. Substratum: good compaction characteristics; high shear strength; low compressibility; high permeability when compacted.
Houghton: Hm, Ho	Poor: organic material oxidizes rapidly; erodible.	Unsuited	Poor: organic material; very poorly drained; poor compaction characteristics; high frost action potential and shrink-swell.	Organic material not suitable; high compressibility; high permeability; unstable.
Lake borders: La. No interpretations. Material too variable.				
Marl beds: Ma	Poor: very poorly drained; thin layer over marl.	Unsuited	Poor: very poorly drained; poor compaction characteristics; high frost action potential; moderate shrink-swell.	Marl not suitable; high compressibility; variable permeability; unstable.

engineering properties—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Rapid seepage in substratum; deep water table; pond size may be restricted in moderately sloping to moderately steep areas.	Not needed; well drained	Complex slopes with potholes; sand and gravelly sand at a depth of 2 to 3½ feet; droughty; difficult to vegetate in cuts.	Sand and gravelly sand at a depth of 2 to 3½ feet; difficult to vegetate in cuts; droughty; complex, short slopes with potholes.
Very slow seepage; seasonal high water table.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; slow or very slow permeability; clayey material requires special attention.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: slow runoff.	Clayey subsoil; difficult to vegetate; seasonal high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Rapid seepage in substratum; high water table; suitable for pit ponds; rapid recharge; subject to cave-in.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; moderately rapid permeability; sandy material requires special attention; ditch banks subject to cave-in.	Needed only to divert runoff from adjoining higher areas. In depressions: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Slow seepage in substratum; seasonal high water table.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; slow or very slow permeability.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: slow runoff.	Soil features favorable; needed only where concentrated flow of water runs in from adjoining higher areas.
Rapid seepage in substratum; seasonal high water table.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; sandy substratum requires special attention.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: slow runoff.	Sand and gravelly sand at a depth of 2 to 3½ feet; needed only where concentrated flow of water runs in from adjoining higher areas.
Rapid seepage; high water table; suitable for pit ponds; rapid recharge; organic material unstable and susceptible to cave-in.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; rapid permeability; subsidence of muck is a problem; outlets often not available; ditchbanks subject to cave-in.	Not needed; nearly level. In depressions: very slow runoff or ponded; organic material.	Generally not needed; high water table; wetness; very slow runoff or ponded.
Variable seepage rate; unstable marl; high water table; suitable for pit type ponds.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; variable permeability; outlets often not available.	Not needed; nearly level in depressions; very slow runoff or ponded.	Generally not needed; high water table; wetness; very slow runoff or ponded.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Marsh: Mb. No interpretations. Material too variable.				
Martinsville: MdB	Good	Unsuited	Fair: fair compaction characteristics; moderate frost action potential.	Subsoil: good to fair compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair compaction characteristics; medium to low shear strength; high susceptibility to piping; medium to low permeability when compacted.
Metea: MeB	Poor: too sandy; droughty; hazard of soil blowing.	Unsuited	Fair: fair to poor compaction characteristics; moderate frost action potential; low shrink-swell.	Subsoil: fair to good compaction characteristics; low to medium compressibility; medium to high susceptibility to piping; medium to low permeability when compacted. Substratum: fair to poor compaction characteristics; medium to low shear strength; medium to low permeability when compacted.
Miami: MfB2, MfC2, MfD2, MfE2	Fair where slopes are 2 to 12 percent. Poor where slopes are more than 12 percent: hazard of erosion; suitable material is somewhat thin; somewhat clayey subsoil.	Unsuited	Fair: fair compaction characteristics; slope; moderate frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair to poor compaction characteristics; medium to low shear strength; low to medium permeability when compacted.
MgC3, MgD3	Fair where slopes are 6 to 12 percent. Poor where slopes are 12 to 18 percent; hazard of erosion; somewhat clayey material.	Unsuited	Fair: fair compaction characteristics; slope; moderate frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair to poor compaction characteristics; medium to low shear strength; low to medium permeability when compacted.
MhA, MhB2	Fair: suitable material is somewhat thin; somewhat clayey subsoil.	Good below a depth of 5 to 10 feet.	Fair in subsoil and upper substratum; fair compaction characteristics; moderate frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Upper substratum: fair to poor compaction characteristics; medium to low shear strength; low to medium permeability when compacted. Lower substratum: good compaction characteristics; low compressibility; high permeability when compacted.

engineering properties—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Medium seepage rate; deep water table; thick sandy strata in substratum in some areas cause rapid seepage.	Not needed; well drained	Medium runoff; mostly short undulating slopes.	Soil features favorable.
Rapid seepage in upper part; medium seepage in lower subsoil and substratum; deep water table.	Not needed; well drained	Sandy; slow runoff; hazard of soil blowing; very rapid permeability in sandy material.	Sandy; slow runoff; difficult to vegetate; hazard of soil blowing; droughty.
Medium seepage; deep water table; slopes may restrict pond size in moderately sloping to moderately steep areas.	Not needed; well drained	Where slopes are 2 to 12 percent: rapid runoff; moderate permeability; features favorable. Where slopes are more than 12 percent: slope; many slopes are short; moderate permeability; very rapid runoff.	Soils features favorable where slopes are less than 12 percent, restrictive where more than 12 percent.
Medium seepage; deep water table; slopes may restrict pond size in moderately to strongly sloping areas.	Not needed; well drained	Slope; clayey subsoil; rapid or very rapid runoff; moderate permeability.	Slope; clayey material; difficult to vegetate.
Medium seepage in upper 5 to 10 feet; rapid seepage in lower substratum; deep water table.	Not needed; well drained	Generally not needed; undulating short slopes with shallow potholes and closed depressions; slow runoff for MhA; rapid runoff for MhB.	Soil features favorable.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Milford: Mn	Poor: poorly drained; somewhat clayey.	Unsuited	Poor: poorly drained; fair to poor compaction characteristics; high frost action potential; moderate or high shrink-swell.	Fair to poor compaction characteristics; medium to low shear strength; medium to high compressibility; low permeability when compacted.
*Morley:				
MrB2, MrC2, MrD2, MuC2. For Miami and Rawson parts of MuC2, see Miami and Rawson series respectively.	Fair where slopes are 2 to 12 percent. Poor where slopes are more than 12 percent: hazard of erosion; suitable material is somewhat thin; clayey subsoil.	Unsuited	Fair to poor: fair compaction characteristics; moderate frost action potential; moderate or high shrink-swell.	Subsoil: fair to poor compaction characteristics; medium to low shear strength; high compressibility; low permeability when compacted. Substratum: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted.
MsC3, MsD3, MtE	Poor: clayey material; slope; hazard of erosion.	Unsuited	Fair to poor: slope; fair compaction characteristics; moderate frost action potential; moderate or high shrink-swell.	Subsoil: fair to poor compaction characteristics; medium to low shear strength; high compressibility; low permeability when compacted. Substratum: fair to good compaction characteristics; medium or low shear strength; low permeability when compacted.
Oshtemo:				
OtA	Good	Good for sand; fair for gravel.	Fair: good compaction characteristics; moderate frost action potential; low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to high susceptibility to piping; medium to low permeability when compacted. Substratum: good compaction characteristics; low compressibility; high permeability when compacted.
OsB, OsC	Poor: too sandy; droughty material; hazard of soil blowing.	Good for sand; fair for gravel.	Fair: good compaction characteristics; moderate frost action potential; low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to high susceptibility to piping; medium to low permeability when compacted. Substratum: good compaction characteristics; low compressibility; high permeability when compacted.
Palms: Pb	Poor: organic material oxidizes rapidly; erodible.	Unsuited	Poor: organic material over loamy mineral material; very poorly drained; poor compaction characteristics; high frost action potential; high shrink-swell in organic material.	Organic material not suitable; high compressibility; high permeability; unstable.
Parr: PdA	Fair: suitable material is somewhat thin; somewhat clayey, subsoil.	Good below a depth of 5 to 10 feet.	Fair in subsoil and upper substratum: fair compaction characteristics: moderate frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Upper substratum: fair compaction characteristics; medium to low shear strength; low to medium permeability when compacted. Lower substratum: good compaction characteristics; low compressibility; high permeability when compacted.

engineering properties—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Slow seepage; high water table; suitable for pit type ponds; slow recharge.	Poorly drained; seasonal high water table at surface or within a depth of 1 foot; moderately slow permeability.	Needed only to divert runoff from adjoining higher areas. In depressions : very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Slow seepage; seasonal high water table at a depth of 3 to more than 6 feet; pond size may be restricted in moderately sloping to steep areas.	Generally not needed; moderately well drained or well drained; drainage may be needed to prevent seepage near base of slopes.	Where slopes are 2 to 12 percent: rapid runoff; slow permeability; features generally favorable; clayey subsoil. Where slopes are more than 12 percent: clayey subsoil; very rapid runoff; slow permeability; slope.	Where slopes are 2 to 12 percent: clayey subsoil; difficult to vegetate; other features favorable. Where slopes are more than 12 percent: clayey subsoil; difficult to vegetate; slope.
Slow seepage; seasonal high water table at a depth of 3 to more than 6 feet; pond size may be restricted in moderately sloping to steep areas.	Generally not needed; moderately well drained or well drained; drainage may be needed to prevent seepage near base of slopes.	Clayey material; difficult to vegetate; rapid or very rapid runoff; slow permeability; slope.	Clayey material; difficult to vegetate; slope.
Rapid seepage in substratum; deep water table.	Not needed; well drained	Generally not needed; nearly level; slow runoff; moderately rapid permeability.	Droughty; generally not needed; nearly level.
Rapid seepage in substratum; deep water table.	Not needed; well drained	Complex slopes with potholes; medium runoff; erodible; subject to soil blowing; moderately rapid permeability; droughty.	Droughty; difficult to establish and maintain vegetation; hazard of soil blowing.
Rapid seepage; high water table; suitable for pit ponds; rapid recharge; organic material unstable.	Very poorly drained; seasonal high water table at surface within a depth of 1 foot; or moderately rapid permeability; subsidence of muck may be a problem; outlets often not available.	Not needed; nearly level in depressions; very slow runoff or ponded; organic material.	Generally not needed; high water table; wetness; very slow runoff or ponded.
Medium seepage in upper 5 to 10 feet; rapid seepage in lower substratum; deep water table.	Not needed; well drained	Generally not needed; nearly level on flats or in shallow, closed depressions; slow runoff.	Generally not needed; nearly level on broad flats or in shallow, closed depressions.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Pewamo: Pe	Poor: very poorly drained; somewhat clayey.	Unsuited	Poor: very poorly drained; fair compaction characteristics; high frost action potential; moderate or high shrink-swell.	Subsoil: fair to poor compaction characteristics; medium to low shear strength; high compressibility; low permeability when compacted. Substratum: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted.
*Rawson:				
RbA, RbB, RdB2 For Miami and Morley parts of RdB2, see Miami and Morley series respectively.	Fair: suitable material is somewhat thin; subsoil somewhat clayey.	Unsuited	Fair: fair compaction characteristics; moderate frost action potential; high or moderate shrink-swell.	Subsoil: fair compaction characteristics; medium to low shear strength; low to medium susceptibility to piping; low permeability when compacted. Substratum: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted.
RaB, RaC2	Fair: suitable material is somewhat thin; subsoil somewhat clayey	Unsuited	Fair: fair compaction characteristics; moderate frost action potential; high or moderate shrink-swell.	Subsoil: fair compaction characteristics; medium to low shear strength; low to medium susceptibility to piping; low permeability when compacted. Substratum: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted.
Rensselaer: Re	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; fair compaction characteristics; high frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low permeability when compacted. Substratum: fair to good compaction characteristics; medium to low shear strength; medium to high susceptibility to piping; medium to low permeability when compacted.
Riddles: RsA, RsB, RsC2, RsD2.	Fair: suitable material is somewhat thin; subsoil somewhat clayey; slopes of more than 8 percent are limiting.	Unsuited	Fair: fair compaction characteristics; moderate frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low to medium susceptibility to piping; low permeability when compacted. Substratum: fair to poor compaction characteristics; medium to low shear strength; low to medium permeability when compacted.
Sebewa: Se	Poor: very poorly drained.	Good	Poor: very poorly drained; good compaction characteristics; high frost action potential; low shrink-swell.	Subsoil: good to fair compaction characteristics; low to medium compressibility; low permeability when compacted. Substratum: good compaction characteristics; high shear strength; low compressibility; high permeability when compacted.

engineering properties—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Slow seepage; high water table; suitable for pit type ponds; slow recharge.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; moderately slow permeability.	Needed only to divert runoff from adjoining higher areas. In depressions: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Slow seepage; seasonal high water table at a depth of 3 to more than 6 feet.	Generally not needed; moderately well drained or well drained; drainage may be needed to prevent seepage near base of slopes.	Slow or medium runoff; slow or very slow permeability; not needed on slopes of less than 2 percent; features favorable on slopes of 2 to 6 percent.	Soil features favorable.
Slow seepage; seasonal high water table at a depth of 3 to more than 6 feet.	Generally not needed; moderately well drained or well drained; drainage may be needed to prevent seepage near base of slopes.	Medium or rapid runoff; slow or very slow permeability; features favorable.	Soil features favorable.
Medium seepage; high water table; suitable for pit type ponds; subject to cave-in.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot, slow permeability; sandy and silty substratum requires special attention.	Needed only to divert runoff from adjoining higher areas. In depressions: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Medium seepage; deep water table; pond size may be restricted in moderately sloping or strongly sloping areas.	Not needed; well drained	Slow runoff in nearly level areas, medium in gently sloping areas, and rapid or very rapid in moderately sloping or strongly sloping areas; moderate permeability; features favorable on slopes of less than 10 percent.	Soil features favorable except in strongly sloping areas.
Rapid seepage in substratum; high water table; suitable for pit type ponds; rapid recharge.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; moderate permeability; sandy substratum requires special attention.	Needed only to divert runoff from adjoining higher areas. In depressions: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Shoals: Sh	Good	Unsuited	Poor: somewhat poorly drained; fair compaction characteristics; low shrink-swell; high frost action potential.	Fair compaction characteristics; medium to low shear strength; high susceptibility to piping; medium to low permeability when compacted.
Toledo: To	Poor: very poorly drained; clayey material.	Unsuited	Poor: very poorly drained; fair to poor compaction characteristics; moderate frost action potential; high shrink-swell.	Fair to poor compaction characteristics; medium to low shear strength; high compressibility; low susceptibility to piping; low permeability when compacted.
Wallkill: Wa	Poor: very poorly drained; other characteristics favorable.	Unsuited	Poor: very poorly drained; substratum is organic material; poor compaction characteristics; high frost action potential; high shrink-swell in organic material.	Subsoil: fair to poor compaction characteristics; medium to low shear strength; high susceptibility to piping; medium to low permeability when compacted. Substratum: organic material not suitable; high compressibility; high permeability; unstable.
Warsaw: WrA	Good	Good	Fair: good compaction characteristics; moderate frost action potential; low shrink-swell.	Subsoil: good to fair compaction characteristics; low to medium compressibility; low permeability when compacted. Substratum: good compaction characteristics; high shear strength; low compressibility; high permeability when compacted.
Washtenaw: Ws	Poor: very poorly drained; other characteristics favorable.	Unsuited	Poor: very poorly drained; fair to poor compaction characteristics; high frost action potential; moderate or high shrink-swell.	Upper subsoil: fair to poor compaction characteristics; medium to low shear strength; high susceptibility to piping; medium to low permeability when compacted. Lower subsoil and substratum: fair compaction characteristics; medium to low shear strength; low permeability when compacted.
Whitaker: Wt	Fair: suitable material is somewhat thin; somewhat clayey subsoil.	Unsuited	Poor: somewhat poorly drained; fair compaction characteristics; high frost action potential; moderate or low shrink-swell.	Subsoil: fair to good compaction characteristics; medium to low shear strength; low to medium susceptibility to piping; low permeability when compacted. Substratum: fair compaction characteristics; medium to low shear strength; high susceptibility to piping; medium to low permeability when compacted.

chanical analyses were made by combined sieve and hydrometer methods (*4*, *5*).

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at a successively higher moisture content, assuming that the compactive effort remains constant, the dry density of the compacted material increases until the *optimum moisture content* is reached. After that, dry density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Tests to determine liquid limit and plastic limit

engineering properties—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Medium seepage; seasonal high water table; sandy strata in substratum in places; subject to flooding in some areas.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; subject to flooding in some areas.	Not needed; bottom land; slow runoff; nearly level; subject to flooding.	Soil features favorable; subject to flooding; needed only where concentrated flow of water runs in from adjoining higher areas.
Very slow seepage; high water table; suitable for pit type ponds; slow recharge.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; slow permeability clayey material requires special attention.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Rapid seepage in organic material; seasonal high water table; rapid recharge; organic material unstable and subject to cave-in; suitable for pit type ponds.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; rapid permeability in organic material; outlets often not available.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: very slow runoff or ponded.	Generally not needed; high water table; wetness; very slow runoff or ponded.
Rapid seepage in substratum; deep water table.	Not needed, well drained	Not needed; nearly level; slow runoff.	Generally not needed; nearly level flats; droughty.
Slow seepage; high water table; suitable for pit type ponds; variable recharge rate.	Very poorly drained; seasonal high water table at surface or within a depth of 1 foot; slow permeability.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: very slow runoff or ponded.	Depressional; high water table; needed only where concentrated flow of water runs in from adjoining higher areas.
Medium seepage; seasonal high water table; thick sandy strata in substratum in places cause rapid seepage.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; sandy and silty substratum requires special attention.	Needed only to divert runoff from adjoining higher areas. In nearly level areas: slow runoff.	Soil features favorable.

measure the effect of water on the consistence of soil material, as is explained under the heading "Soil Properties Significant in Engineering."

Soil properties significant in engineering

Estimates of soil properties significant in engineering are given in table 6. These estimates are made for typical profiles by layers sufficiently different from each other to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 6.

Depth to seasonal high water table is distance from the surface of the soil down to the highest level reached in most years by ground water.

Potential frost action refers to the probable effects on structures resulting from the freezing of soil material and its subsequent thawing. These effects are important factors mainly in selecting sites for highways and runways, but also in planning any structure that is to be supported or bordered by soil that freezes. Ratings given are high, medium, and low and refer to the probability of damage.

Depth from surface is given in inches for major horizons or for special horizons that have engineering properties significantly different from adjacent horizons. Depth to bedrock is not given in the table because all soils in the county are so deep that bedrock does not affect their use.

Dominant USDA texture is described in table 6 in the standard terms used by the Department of Agriculture. These terms are based on the percentages of sand, silt, and clay less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary.

Percentage passing sieve shows percentages of material that pass through three standard sieves. It indicates the grain-size distribution of the soil.

Liquid limit and plasticity index are water contents obtained by specified operations. As the water content of a dry clayey soil from which the particles coarser than 0.42 millimeter have been removed is increased, the material changes from semisolid to plastic. If the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic; and the liquid limit, from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 6, but in table 5 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is the quality that enables a soil to transmit water or air. In table 6 it is expressed as the estimated rate at which saturated soil transmits water in a vertical direction under a unit head of pressure. It is estimated on the basis of those soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage or such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is the estimated ability of soils to hold water for use by most plants. It is defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values for a soil-solution mixture. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected of soil material as moisture content changes, that is, the extent to which the soil shrinks when dry or swells when wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soil causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Engineering interpretations

The interpretations in table 7 are based on the engineering properties of soils shown in table 6, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Noble County. In table 7, ratings of good, fair, and poor are used to summarize suitability of the soils for topsoil, sand and gravel, and road fill. For all other uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Following are explanations of the columns in table 7.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, for example, in preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. It is also affected by the texture of the soil material and its content of stone fragments. Also considered in the ratings is the damage that results in the area from which topsoil is removed.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the material, and they do not indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage, and the ease of excavating the material at borrow areas.

Embankments, dikes, and levees require soil material that is resistant to seepage and piping and has favorable stability, shrink-swell potential, shear strength, and compactibility. The presence of stones or organic material in a soil is among factors that are unfavorable.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure;

depth to claypan, rock or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Grassed waterways are vegetated, shallow, broad channels that receive runoff and carry it safely downslope to streams or water courses. Features that affect construction of waterways are slope, runoff, texture, permeability, resistance to erosion, and features that affect the establishment and growth of plants.

Town and Country Planning

Residential, commercial, industrial, and institutional developments are growing in Noble County as the suburbs of towns expand into the rural areas. This expansion has led to many problems that show the need for careful planning and for understanding of the broad physical and economic aspects involved when land use changes.

This survey is intended to help plan these developments and solve the problems. Planning officials and developers, as well as homeowners and others, can find useful information on the soil maps, in the text, and in the tables. The detailed soil maps in the back of the survey are useful because they show the location of each of the soils in the county. The general soil map shows the pattern of the major soils in the county. All of the soils are described in detail under the heading "Descriptions of the Soils."

In table 8 the soils of Noble County are rated for their limitations for town and country planning. The soils are evaluated only to a depth of 5 feet or less. They are rated on the basis of three classes of soil limitations. A rating of *slight* means that the soil is nearly free of limitations and the facility is easily created, improved, or maintained. A *moderate* rating means that limitations need to be recognized but can be overcome under good management and careful design. A *severe* rating means that limitations are severe enough to make use questionable, and extreme measures are needed to overcome limitations.

The information in table 8, along with information in other parts of the survey, can serve as a guide in the use of soil data. Before construction begins, however, investigation should be made at the site.

The paragraphs that follow define the town and country uses specified in table 8 and indicate the properties important in determining the limitations for these uses.

Dwellings.—Interpretations are for undisturbed soils that are evaluated to a depth of 5 feet for single family dwellings and other structures, no more than three stories high, having similar foundation requirements. The emphasis in rating soils for dwellings with basements is on the cost of excavation, the bearing strength of the foundation, and the drainage around the basement. Sound construction techniques provide adequate drainage around the foundation or footer to prevent undue settlement and wet basements. Also considered are factors that influence installation of utility lines, such as those between dwellings and the trunk lines. Soil characteristics affecting construction of dwellings are drainage, seasonal high water table, hazard of flooding, slope, shrink-swell potential, texture, potential frost action, and depth to bedrock. Onsite investigation is needed for specific placement of buildings and utility lines and for detailed design of foundations.

Commercial or light industrial development.—Interpretations are for shopping centers and small industrial buildings with foundation requirements not exceeding those of ordinary three-story dwellings. The cost of excavation, the bearing strength of the foundation, and the drainage needed are determined by soil characteristics. Sound construction techniques provide adequate drainage around the foundation or footer to prevent undue settlement. Soil characteristics affecting industrial or commercial sites are drainage, depth to seasonal high water table, hazard of flooding, slope, shrink-swell potential, texture, potential frost action, and depth to bedrock. Onsite investigation is needed for specific placement of buildings and utility lines and for detailed design of foundations.

Landscaping and lawns.—The establishment of lawns and shrubs is important in most residential areas and around many commercial sites. Some soil characteristics that are limitations for landscaping and lawns are not limitations for building. The soil characteristics affecting the establishment and maintenance of lawns and shrubs are slope, drainage, depth to seasonal high water table, hazards of flooding and ponding, available water capacity, texture, hazard of erosion, and depth to a root-restricting layer.

Local roads and streets and parking lots.—Interpretations are for surfaces that carry automobile traffic all year. These surfaces have a subgrade of underlying cut or fill material; a base of gravel, crushed rock, or soil stabilized with lime or cement; and a pavement that is generally asphalt or concrete. It is assumed that the subgrade for roads, streets, and parking lots is built mainly from the soil at hand and cuts and fills are limited generally to less than 6 feet. Soil characteristics that affect construction are drainage, flooding, slope, depth to bedrock, texture, shrink-swell potential, and susceptibility to frost action.

Septic tank absorption fields.—Septic tank absorption fields are used to dispose of sewage where central sewage treatment is unavailable. A system generally consists of a septic tank for holding solid wastes, a distribution box for dispensing effluent and a tile disposal field. Successful operation of the system depends upon the ability of the soil to absorb and filter the liquid effluent passed through the tile field. Soil characteristics that impair proper absorption and filtering of the effluent cause health hazards. Soil characteristics affecting operation are permeability, depth to

TABLE 8.—*Degree and kind of limitation to be*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. fully the instructions for referring to other series

Soil series and map symbols	Dwellings [1]		Commercial or light industrial development [1]	Landscaping and lawns
	With basements	Without basements		
Adrian: Ad, Am	Severe: very poorly drained; organic soil.	Severe: very poorly drained; organic soil.	Severe: very poorly drained; organic soil.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; organic soil, turf easily damaged; very poor trafficability.
Aubbeenaubbee: Au	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained; moderate shrink-swell.	Moderate: somewhat poorly drained; moderate shrink-swell.	Slight
Blount: BlA, BlB2	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained; moderate shrink-swell; somewhat clayey material.	Moderate: somewhat poorly drained; moderate shrink-swell; somewhat clayey material.	Slight
Boyer:				
BoB	Slight	Slight	Moderate: slope	Moderate: somewhat droughty and sandy.
BoC	Moderate: slope	Moderate: slope	Severe: slope	Moderate: somewhat droughty and sandy.
BoD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope; somewhat droughty and sandy.
Brady: Br	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Slight
Brookston: Bx	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Moderate: very poorly drained; turf easily damaged when wet; somewhat clayey subsoil restricts drainage.
Casco: CcC3	Moderate: slope	Moderate: slope	Severe: slope	Severe: droughty; slope; somewhat clayey; shallow over sand and gravelly sand.
Chelsea:				
ChB	Slight	Slight	Moderate: slope	Severe: very droughty; sandy; erodible; turf difficult to maintain.
ChC	Moderate: slope	Moderate: slope	Severe: slope	Severe: very droughty; sandy; erodible; turf difficult to maintain.
Crosier: CrA	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained; moderate shrink-swell.	Moderate: somewhat poorly drained; moderate shrink-swell.	Slight
Edwards: Ed, Em	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material; seasonal high water table within a depth of 1 foot; subject to ponding; turf easily damaged; very poor trafficability.

considered in town and country planning

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow care-that appear in the first column of this table]

Local roads and streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Severe: very poorly drained; organic soil; high shrink-swell; high frost action potential.	Severe: [2] organic soil; seasonal high water table; subject to ponding; rapid permeability.	Severe: seasonal high water table at the surface; subject to ponding; very high organic-matter content; very rapid permeability; severe hazard of seepage.	Severe: seasonal high water table at the surface; subject to ponding; organic soil; very rapid permeability.
Severe: high frost action potential.	Severe: seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Moderate: seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Moderate: seasonal high water table at a depth of 1 foot to 3 feet.
Severe: clayey subsoil; high shrink-swell; high frost action potential.	Severe: seasonal high water table at a depth of 1 foot to 3 feet; slow permeability.	Slight if slope is 0 to 2 percent, moderate if 2 to 4 percent.	Moderate: seasonal high water table at a depth of 1 foot to 3 feet; somewhat clayey material restricts workability.
Moderate: moderate frost action potential.	Slight [2]	Severe: moderately rapid permeability; severe hazard of seepage.	Severe: moderately rapid permeability; hazard of free leachate flow to ground water.
Moderate: slope; moderate frost action potential.	Moderate: [2] slope; moderately rapid permeability.	Severe: moderately rapid permeability; severe hazard of seepage.	Severe: moderately rapid permeability; hazard of free leachate flow to ground water.
Severe: slope	Severe: [2] slope; moderately rapid permeability.	Severe: moderately rapid permeability; severe hazard of seepage.	Severe: moderately rapid permeability; hazard of free leachate flow to ground water.
Severe: somewhat poorly drained; high frost action potential.	Severe: [2] seasonal high water table at a depth of 1 foot to 3 feet; moderately rapid permeability.	Severe: moderately rapid permeability; severe hazard of seepage.	Severe: moderately rapid permeability; hazard of free leachate flow to ground water.
Severe: somewhat poorly drained; somewhat clayey subsoil; high frost action potential.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; moderate permeability.	Severe: seasonal high water table at surface; subject to ponding; moderate permeability.	Severe: seasonal high water within a depth of 1 foot; subject to ponding.
Moderate: slope; moderate frost action potential.	Moderate: [2] slope; moderate permeability.	Severe: very rapid permeability in substratum; severe hazard of seepage; slope.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Slight	Slight [2]	Severe: rapid permeability; severe hazard of seepage.	Severe: rapid permeability; hazard of free leachate flow to ground water; too sandy for cover.
Moderate: slope	Moderate: [2] slope	Severe: rapid permeability; severe hazard of seepage; slope.	Severe: rapid permeability; hazard of free leachate flow to ground water; too sandy for cover.
Severe: high frost action potential; somewhat clayey subsoil.	Severe: seasonal high water table at a depth of 1 foot to 3 feet; moderately slow permeability.	Slight	Moderate: seasonal high water table at a depth of 1 foot to 3 feet.
Severe: very poorly drained; organic material; high shrink-swell; high frost action potential.	Severe: organic material; high water table; subject to ponding.	Severe: seasonal high water table at surface; subject to ponding; very high organic-matter content; rapid permeability.	Severe: seasonal high water table at surface; subject to ponding; organic material.

TABLE 8.—*Degree and kind of limitation to be*

Soil series and map symbols	Dwellings [1]		Commercial or light industrial development [1]	Landscaping and lawns
	With basements	Without basements		
*Fox: FoA	Slight	Slight	Slight	Slight to moderate: somewhat shallow and droughty.
FoB	Slight	Slight	Moderate: slope	Slight to moderate: somewhat shallow and droughty.
FoC2	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope; somewhat shallow and droughty.
FsD2, FsE2 For Casco parts of FsD2 and FsE2, see Casco series.	Severe: slope	Severe: slope	Severe: slope	Moderate: slope; somewhat shallow and droughty.
Fulton: Fu	Severe: somewhat poorly drained; high shrink-swell; clayey.	Severe: somewhat poorly drained; high shrink-swell; clayey.	Severe: somewhat poorly drained; high shrink-swell; clayey.	Slight to moderate: clayey subsoil severely restricts drainage.
Gilford: Gf	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet.
Haskins: HaA	Severe: somewhat poorly drained; moderate or high shrink-swell.	Moderate: somewhat poorly drained; moderate or high shrink-swell; clayey.	Moderate: somewhat poorly drained; moderate or high shrink-swell; clayey.	Slight
Homer: Hh	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Slight to moderate: somewhat shallow.
Houghton: Hm, Ho	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material; seasonal high water table within a depth of 1 foot, subject to ponding; turf easily damaged; very poor trafficability.
Lake borders: La. Material too variable to be rated.				
Marl beds: Ma	Severe: very poorly drained; marl substratum.	Severe: very poorly drained; marl substratum.	Severe: very poorly drained; marl substratum.	Severe: very poorly drained; marl near surface; seasonal high water table within a depth of 1 foot; subject to ponding; turf easily damaged; poor trafficability.
Marsh: Mb. Material too variable to be rated.				
Martinsville: MdB	Slight	Slight	Moderate: slope	Slight
Metea: MeB	Slight	Slight	Moderate: slope	Moderate: droughty; sandy; erodible; turf difficult to maintain.

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Local roads and streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Moderate: moderate frost action potential.	Slight [2]	Severe: very rapid permeability in substratum; severe hazard of seepage.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Moderate: moderate frost action potential.	Slight [2]	Severe: very rapid permeability in substratum; severe hazard of seepage.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Moderate: slope; moderate frost action potential.	Moderate: [2] slope	Severe: very rapid permeability in substratum; severe hazard of seepage; slope.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Severe: slope	Severe: [2] slope	Severe: very rapid permeability in substratum; severe hazard of seepage; slope.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Severe: somewhat poorly drained; very clayey; high shrink-swell.	Severe: seasonal high water table at a depth of 1 foot to 3 feet; slow and very slow permeability.	Slight	Severe: clayey material severely restricts workability.
Severe: very poorly drained; high frost action potential.	Severe: [2] seasonal high water table within a depth of 1 foot; subject to ponding.	Severe: seasonal high water at surface; subject to ponding; moderately rapid permeability; severe hazard of seepage.	Severe: seasonal high water table at surface; subject to ponding; moderately rapid permeability; hazard of free leachate flow to ground water.
Severe: somewhat clayey subsoil; high frost action potential.	Severe: seasonal high water table at a depth of 1 foot to 3 feet; slow or very slow permeability.	Slight	Moderate: seasonal high water table at a depth of 1 foot to 3 feet; somewhat clayey material restricts workability.
Severe: high frost action potential.	Severe: [2] seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Severe: very rapid permeability in substratum; severe hazard of seepage.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Severe: very poorly drained; organic material; high shrink-swell; high frost action potential.	Severe: organic material; high water table; subject to ponding.	Severe: rapid permeability; seasonal high water table at surface; subject to ponding; very high organic-matter content.	Severe: seasonal high water table at surface; subject to ponding; organic material.
Severe: very poorly drained; marl substratum; high frost action potential.	Severe: high water table; subject to ponding.	Severe: seasonal high water table at surface; subject to ponding; variable permeability.	Severe: seasonal high water table at surface; subject to ponding.
Moderate: somewhat clayey; moderate shrink-swell; moderate frost action potential.	Slight [3]	Severe: moderately rapid permeability in substratum; severe hazard of seepage.	Severe: moderately rapid permeability; stratified silty and sandy substratum; hazard of free leachate flow to ground water.
Moderate: moderate frost action potential.	Moderate: moderate permeability where slopes are more than 6 percent; seepage at base of slopes.	Moderate: moderate permeability; moderate hazard of seepage; severe hazard of seepage in loamy sand in upper part; slope hinders development of site.	Slight.

TABLE 8.—*Degree and kind of limitation to be*

Soil series and map symbols	Dwellings [1]		Commercial or light industrial development [1]	Landscaping and lawns
	With basements	Without basements		
Miami:				
MfB2	Slight	Slight	Moderate: slope	Slight
MfC2	Moderate: slope	Moderate: slope	Severe: slope	Slight
MfD2, MfE2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
MgC3	Moderate: slope	Moderate: slope	Severe: slope	Moderate: somewhat clayey
MgD3	Severe: slope	Severe: slope	Severe: slope	Moderate: slope; somewhat clayey.
MhA	Slight	Slight	Slight	Slight
MhB2	Slight	Slight	Moderate: slope	Slight
Milford: Mn	Severe: poorly drained.	Severe: poorly drained; high shrink-swell.	Severe: poorly drained; high shrink-swell.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet; somewhat clayey subsoil restricts drainage.
*Morley:				
MrB2	Moderate: moderate shrink-swell.	Moderate: moderate shrink-swell.	Moderate: slope; moderate shrink-swell.	Slight
MrC2, MuC2 For Miami and Rawson parts of MuC2, see Miami and Rawson series respectively.	Moderate: slope, moderate shrink-swell.	Moderate: moderate shrink-swell; slope.	Severe: slope	Slight
MrD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
MsC3	Moderate: slope; moderate shrink-swell.	Moderate: slope; moderate shrink-swell.	Severe: slope	Moderate: somewhat clayey
MsD3, MtE	Severe: slope	Severe: slope	Severe: slope	Moderate: slope; somewhat clayey.
Oshtemo:				
OsB	Slight	Slight	Moderate: slope	Moderate: somewhat droughty and sandy.
OsC	Moderate: slope	Moderate: slope	Severe: slope	Moderate: somewhat droughty and sandy.

considered in town and country planning—Continued

Local roads and streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Moderate: somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: moderate permeability.	Moderate: moderate permeability; moderate hazard of seepage; slope.	Slight.
Moderate: slope; somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: moderate permeability; slope; seepage of effluent at base of slopes.	Severe: slope	Slight.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope hinders development of site.
Moderate: somewhat clayey; moderate shrink-swell; slope; moderate frost action potential.	Moderate: moderate permeability; slope; seepage of effluent at base of slopes.	Severe: slope	Slight.
Severe: slope	Severe: slope	Severe: slope	Moderate: slope hinders development of site.
Moderate: somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: [2] moderate permeability.	Severe: very rapid permeability in lower substratum; severe hazard of seepage.	Severe: very rapid permeability in lower substratum; hazard of free leachate flow to ground water.
Moderate: somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: [2] moderate permeability.	Severe: very rapid permeability in lower substratum; severe hazard of seepage.	Severe: very rapid permeability in lower substratum; hazard of free leachate flow to ground water.
Severe: poorly drained; clayey subsoil; high shrink-swell; high frost action potential.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; moderately slow permeability.	Moderate: high organic-matter content.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; somewhat clayey material restricts workability.
Severe: clayey subsoil	Severe: slow permeability	Moderate: slope hinders development of site; slow permeability.	Moderate: somewhat clayey material restricts workability.
Severe: clayey subsoil	Severe: slow permeability; slope; seepage of effluent at base of slopes.	Severe: slope hinders development of site.	Moderate: somewhat clayey material restricts workability.
Severe: slope; clayey subsoil	Severe: slow permeability; slope; seepage of effluent at base of slopes.	Severe: slope hinders development of site.	Moderate: somewhat clayey material restricts workability; slope hinders development of site.
Severe: clayey	Severe: slow permeability; slope; seepage of effluent at base of slopes.	Severe: slope hinders development of site.	Moderate: somewhat clayey material restricts workability.
Severe: slope; clayey	Severe: slow permeability; slope; seepage of effluent at base of slopes.	Severe: slope hinders development of site.	Moderate: somewhat clayey material restricts workability; slope hinders development of site.
Moderate: moderate frost action potential.	Slight [2]	Severe: moderately rapid permeability; severe hazard of seepage.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Moderate: slope; moderate frost action potential.	Moderate: [2] slope	Severe: moderately rapid permeability; severe hazard of seepage; slope.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.

TABLE 8.—*Degree and kind of limitation to be*

Soil series and map symbols	Dwellings [1]		Commercial or light industrial development [1]	Landscaping and lawns
	With basements	Without basements		
OtA	Slight	Slight	Slight	Moderate: somewhat droughty.
Palms: Pb	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material; seasonal high water table within a depth of 1 foot; subject to ponding; turf easily damaged; very poor trafficability.
Parr: PdA	Slight	Slight	Slight	Slight
Pewamo: Pe	Severe: very poorly drained.	Severe: very poorly drained; high shrink-swell.	Severe: very poorly drained; high shrink-swell.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet.
*Rawson:				
RbA	Moderate: moderate shrink-swell.	Moderate: moderate to high shrink-swell.	Moderate: moderate to high shrink-swell.	Slight
RdB2, RaB, RbB For Miami and Morley parts of RdB2, see Miami and Morley series respectively.	Moderate: moderate shrink-swell.	Moderate: moderate to high shrink-swell.	Moderate: moderate to high shrink-swell; slope.	Slight
RaC2	Moderate: moderate to high shrink-swell; slope.	Moderate: moderate to high shrink-swell; slope.	Severe: slope	Slight
Rensselaer: Re	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet.
Riddles:				
RsA	Slight	Slight	Slight	Slight
RsB	Slight	Slight	Moderate: slope; moderate shrink-swell.	Slight
RsC2	Moderate: slope	Moderate: slope; moderate shrink-swell.	Severe: slope	Slight
RsD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
Sebewa: Se	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet.
Shoals: Sh	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding.	Slight

considered in town and country planning—Continued

Local roads and streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Moderate: moderate frost action potential.	Slight [2]	Severe: moderately rapid permeability; severe hazard of seepage.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Severe: very poorly drained; organic material; high shrink-swell; high frost action potential.	Severe: organic material; high water table; subject to ponding.	Severe: seasonal high water table at surface; subject to ponding; very high organic-matter content.	Severe: seasonal high water table at surface; subject to ponding; organic material.
Moderate: somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: moderate permeability.	Severe: very rapid permeability in lower substratum; severe hazard of seepage.	Severe: very rapid permeability in lower substratum; hazard of free leachate flow to ground water.
Severe: very poorly drained; somewhat clayey subsoil; high shrink-swell; high frost action potential.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; moderately slow permeability.	Moderate: high organic-matter content.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; somewhat clayey material restricts workability.
Moderate: somewhat clayey; moderate shrink-swell; moderate frost action potential.	Severe: slow or very slow permeability.	Slight	Moderate: somewhat clayey material restricts workability.
Moderate: somewhat clayey; moderate shrink-swell; moderate frost action potential.	Severe: slow or very slow permeability.	Moderate: slope hinders development of site.	Moderate: somewhat clayey material restricts workability.
Moderate: somewhat clayey; moderate shrink-swell; moderate frost action potential.	Severe: slow or very slow permeability.	Severe: slope hinders development of site.	Moderate: somewhat clayey material restricts workability.
Severe: very poorly drained; high frost action potential.	Severe: [3] seasonal high water table within a depth of 1 foot; subject to ponding; slow permeability.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; severe hazard of seepage.	Severe: seasonal high water within a depth of 1 foot; subject to ponding; stratified silty and sandy substratum; hazard of free leachate flow to ground water.
Moderate: somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: moderate permeability.	Moderate: moderate permeability; moderate hazard of seepage.	Slight.
Moderate: somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: moderate permeability.	Moderate: slope hinders site development; moderate permeability; moderate hazard of seepage.	Slight.
Moderate: slope; somewhat clayey subsoil; moderate shrink-swell; moderate frost action potential.	Moderate: moderate permeability; slope.	Severe: slope hinders site development.	Slight.
Severe: slope	Severe: moderate permeability; slope.	Severe: slope hinders site development.	Moderate: slope hinders development of site.
Severe: very poorly drained; high frost action potential.	Severe: [2] seasonal high water table within a depth of 1 foot; subject to ponding; moderate permeability.	Severe: rapid permeability in substratum; severe hazard of seepage.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; rapid permeability in substratum; hazard of free leachate flow to ground water.
Severe: subject to occasional flooding; high frost action potential.	Severe: subject to occasional flooding; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; subject to occasional flooding.	Severe: subject to occasional flooding.

TABLE 8.—*Degree and kind of limitation to be*

Soil series and map symbols	Dwellings [1]		Commercial or light industrial development [1]	Landscaping and lawns
	With basements	Without basements		
Toledo: To	Severe: very poorly drained; high shrink-swell; clayey.	Severe: very poorly drained; high shrink-swell; clayey.	Severe: very poorly drained; high shrink-swell; clayey.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet.
Wallkill: Wa	Severe: very poorly drained; alluvial soil over organic material.	Severe: very poorly drained; alluvial soil over organic material.	Severe: very poorly drained; alluvial soil over organic material.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; alluvial soil over organic material; poor trafficability; turf easily damaged when wet.
Warsaw: WrA	Slight	Slight	Slight	Slight to moderate: somewhat shallow.
Washtenaw: Ws	Severe: very poorly drained; moderate or high shrink-swell.	Severe: very poorly drained; moderate or high shrink-swell.	Severe: very poorly drained; moderate or high shrink-swell.	Moderate: seasonal high water table within a depth of 1 foot; subject to ponding; poor trafficability; turf easily damaged when wet.
Whitaker: Wt	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Slight

[1] Footings are assumed to be placed below frost depth.
[2] These soils are underlain with very rapidly permeable, loose sand or sand and gravelly sand. Pollution of nearby shallow wells is a hazard.

seasonal high water table, flooding, slope, and depth to hardpan, bedrock, or other impervious material.

Sewage lagoons.—These are shallow lakes that hold sewage for the time required for bacterial decomposition. A suitable site should provide an impoundment area and enough soil material to make the dam structure. The completed lagoon must be able to hold water and have minimum seepage and prevent contamination of water supplies. Soil characteristics affecting sewage lagoons are depth to seasonal high water table, permeability, depth to bedrock, slope, coarse fragments, organic-matter content, hazard of flooding, and texture.

Sanitary landfill.—These are disposal areas for trash and garbage. The soils are rated for the trench type of landfill. A good sanitary landfill operates without contaminating water supplies, reducing esthetic land values, or causing health hazards and is usable all year. Fill areas that have been adequately compacted and covered can be used for parking areas, parks, and recreation areas. Soil characteristics affecting the establishment and operation of a sanitary landfill are depth to seasonal high water table, drainage, flooding, permeability, slope, texture, and depth to bedrock.

Routine investigations are normally confined to depths of about 5 to 6 feet, but many trenches are as deep as 15 feet or more. Therefore, an investigation of the area to determine the potential of pollution to ground water and to obtain the design of the landfill should be made. The soil survey is valuable in selecting potential sites and determining where additional investigations appear warranted.

Trees and Shrubs [4]

This section provides information on the kinds of trees and shrubs growing on the soils in Noble County and suggests desirable species to keep for certain uses and suitable trees and shrubs for planting.

Tree-covered areas must be evaluated for their community benefits in addition to their value for wood crops. These areas have a longtime value for the following:

1. Wind protection.—Scattered trees and wooded tracts tend to break up regular wind patterns and reduce velocity.
2. Wildlife.—Wooded areas are essential for songbirds and many other forms of wildlife.
3. Erosion reduction.—Trees are excellent for controlling erosion and in many locations provide a filter strip for streams and reservoirs.
4. Recreation and education.—Wooded tracts provide sites for county parks, outdoor laboratories for schools, and nature study.
5. Air pollution control.—Trees are important in the reduction of air pollution. They release moisture and oxygen into the atmosphere and have a cooling and purifying effect.
6. Environmental improvement.—Wooded tracts add scenic beauty and help to create a healthful and pleasing environment in which to live. They provide a screen for unsightly areas and serve as a noise barrier.

[4] MITCHELL G. HASSLER, woodland conservationist, Soil Conservation Service, helped prepare this section.

considered in town and country planning—Continued

Local roads and streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Severe: very poorly drained; high shrink-swell; very clayey.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; slow permeability.	Moderate: high organic-matter content.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; clayey material severely restricts workability.
Severe: very poorly drained; high frost action potential; organic material in substratum.	Severe: seasonal high water table; subject to ponding.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; high organic-matter content in substratum; severe hazard of seepage.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; organic material in substratum; very rapid permeability in substratum.
Moderate: moderate frost action potential.	Slight [5]	Severe: very rapid permeability in substratum; severe hazard of seepage.	Severe: very rapid permeability in substratum; hazard of free leachate flow to ground water.
Severe: very poorly drained; high frost action potential.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding; slow permeability; medium organic-matter content.	Severe: [6] seasonal high water table within a depth of 1 foot; subject to ponding; slow permeability.	Severe: seasonal high water table within a depth of 1 foot; subject to ponding.
Severe: somewhat clayey subsoil; high frost action potential.	Severe: [5] seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Severe: permeable substratum; severe hazard of seepage.	Severe: stratified silty and sandy substratum; hazard of free leachate flow to ground water.

[5] These soils are underlain with stratified, medium textured, moderately coarse textured, and coarse textured material. Pollution of nearby shallow wells is a hazard where strata of coarse textured material are extensive.
[6] Moderate if the floor of the lagoon is in nearby impermeable material at least 2 feet thick.

In table 9, the soils of Noble County have been assigned to five broad tree and shrub groups. This table lists some of the trees and shrubs that grow naturally on soils in each of the five groups and should be retained when developing an area for more intensive use. It also lists many trees and shrubs suitable for planting in a wide variety of environmental improvement projects. To determine which group a soil is in, refer to the "Guide to Mapping Units" at the back of this survey.

Table 9 does not list all plants that grow on a soil or that are suitable for planting. Assistance in acquiring and arranging plants and preparing sites should be obtained from local landscape architects, commercial nurseries, or forestry specialists.

Recreation

Outdoor recreational activity, already a major part of American life, will triple by the year 2000. Outdoor recreation should be an integral element in local land-use planning (*6*).

The proximity of Noble County to centers of population, the landscape, the soils, and the resources of the county make it possible to develop recreational facilities. Some of these facilities are in Chain-O-Lakes State Park, Tri-County State Fish and Game Area, and Bixler Lake Park.

In table 10, the soils in Noble County are rated according to their limitations for developing recreational facilities. These facilities are described in the following paragraphs.

Camp areas.—These are areas suitable as tent and camp trailer sites. Little site preparation is needed other than shaping and leveling for tent and parking areas. The soils should be suitable for unsurfaced parking of camper trucks and trailers, for heavy foot traffic, and for limited vehicular traffic. Soil characteristics considered are wetness, hazard of flooding, permeability, slope, texture, coarse fragments, and stoniness or rockiness. Suitability for growing and maintaining vegetation was not considered in the ratings, but should be considered in final evaluation of the site.

Picnic areas.—These are areas suitable for heavy foot traffic. Most vehicular traffic is confined to access roads. Soil characteristics considered are wetness, hazard of flooding, slope, texture, coarse fragments on the surface, stoniness, and rockiness. Suitability for growing and maintaining vegetation was not considered in the ratings, but should be considered in final evaluation of the site.

Playgrounds.—These areas are subject to intensive foot traffic and generally require a level surface, good drainage, and a texture and consistence that result in a firm surface. The most desirable soils are free of rock outcrops and coarse fragments. Soil characteristics considered are wetness, hazard of flooding, permeability, slope, texture, depth to bedrock, coarse fragments, and stoniness or rockiness. Suitability for growing and maintaining vegetation was not considered in the ratings, but should be considered in final evaluation of the site.

Paths and trails.—These areas are local and cross-country paths and trails and bridle paths. Little or no

TABLE 9.—*Trees*

[No data for Lake borders, Marl beds,

Tree and shrub groups	Trees to be retained on home and park sites
Group 1. Very poorly drained, nearly level depressional soils; moderately deep or deep over sand and gravelly sand; seasonal high water table within a depth of 1 foot; some subject to ponding; both mineral soils and mucks; moderate to very high available water capacity; wetness a limitation. Adrian, Brookston, Edwards, Gilford, Houghton, Milford, Palms, Pewamo, Rensselaer, Sebewa, Toledo, Wallkill, and Washtenaw soils.	Pin oak, red maple, bur oak, white ash, sweetgum, black ash.
Group 2. Somewhat poorly drained, nearly level or gently sloping soils; moderately deep or deep over sand and gravelly sand; seasonal high water table at a depth of 1 foot to 3 feet; Shoals soil subject to flooding; moderate or high available water capacity. Aubbeenaubbee, Blount, Brady, Crosier, Fulton, Haskins, Homer, Shoals, and Whitaker soils.	White ash, red maple, bur oak, pin oak, tulip-poplar, sweetgum, swamp chestnut oak.
Group 3. Deep, well drained or moderately well drained, nearly level to moderately steep soils; seasonal high water table at a depth of 3 to 6 feet or more; high available water capacity. Martinsville, Miami, Morley, Parr, Rawson, and Riddles soils.	Red oak, white oak, white ash, tulip-poplar, black walnut, sugar maple.
Group 4. Well drained, nearly level to moderately steep soils; moderately deep or deep over sand and gravelly sand; seasonal high water table at a depth of more than 6 feet; moderate available water capacity. Fox, Metea, Oshtemo, and Warsaw soils.	Black oak, tulip-poplar, red oak, white oak, black walnut, black cherry, white ash, sugar maple.
Group 5. Well drained to excessively drained, gently sloping to strongly sloping soils; shallow to deep over sand and gravelly sand; seasonal high water table at a depth of more than 6 feet; low available water capacity; droughty. Boyer, Casco, and Chelsea soils.	Black oak, white oak, black cherry

excavating or filling is required. Soil features that affect trafficability, dust, and design are given special emphasis. Soil characteristics considered are wetness, hazard of flooding, slope, texture, coarse fragments on the surface, and rockiness or stoniness. Many soils with several limitations are the most interesting from an esthetic and naturalist viewpoint. A rating of severe indicates that a path or trail is costly to build and maintain, but should not preclude its construction.

Golf course fairways.—In evaluating soils for use in golf courses, consideration was given only to those features that affect their use for fairways (fig. 16). Greens, traps, and hazards are man made, generally from disturbed, transported soil material. The best soils are well drained and firm, are free of water during use, have good trafficability, contain a minimum of coarse fragments or stones, and have gently undulating slopes. They are capable of supporting a good turf and are well suited to many kinds of trees and shrubs. Loamy soils are best, but coarser textured soils serve equally well if irrigated. Poorly drained mineral soils have severe limitations, but they can be used as pond sites to provide esthetic value or water for maintenance of turf. Sandy soils can be designed for hazards or used as a source of sand for greens. Soil characteristics considered are depth to seasonal high water table, drainage, surface stoniness or rockiness, hazard of flooding, texture, and slope.

Limitations in table 10 are expressed as slight, moderate, and severe. For a rating other than slight, the kind of limitation is specified. A rating of *slight* means that the facility is easily created, improved, or maintained. Few or no limitations affect design or management. A *moderate* limitation means that the facility generally can be created, improved, or maintained but moderate soil limitations affect design and management. A rating of *severe* means that establishing the facility is questionable or impractical. Extreme measures are needed to overcome limitations.

In selecting a site for a particular use, the limitation

and shrubs

and Marsh. Properties too variable]

Plantings for windbreak screens and sound barriers	Plantings for beauty and shade	Planting to attract songbirds and wildlife
American arborvitae, Lombardy poplar, gray dogwood, red-osier dogwood, silky dogwood, Amur honeysuckle, blue arctic willow, purple willow (medium), purple willow (tall).	American arborvitae, European larch, black sour-gum, red sweetgum, Red River birch, pin oak, red maple, Lombardy poplar, weeping willow, black spruce.	American arborvitae, black sour-gum, pin oak, red maple, black spruce, gray dogwood, red-osier dogwood, silky dogwood, elderberry, Amur honeysuckle, buttonbush, trumpetcreeper.
White pine, Norway spruce, white spruce, tulip-poplar, pin oak, basswood, autumn-olive, Amur honeysuckle, highbush cranberry, blackhaw (viburnum), shadbush (serviceberry), arrowwood (viburnum), cornelian cherry (dogwood), althea (rose-of-Sharon), cutleaf sumac.	White pine, white spruce, baldcypress, basswood, cornelian cherry (dogwood), cutleaf sumac.	White pine, Norway spruce, white spruce, tulip-poplar, pin oak, basswood, autumn-olive, Amur honeysuckle, highbush cranberry, spicebush, blackhaw (viburnum), maple leaf (viburnum), shadbush (serviceberry), arrowwood (viburnum), mapleleaf (viburnum), wood), cutleaf sumac, trumpetcreeper, ground euonymus.
White pine, red pine, Norway spruce, hemlock (Canadian), blackgum, honeylocust (thornless), autumn-olive, Amur honeysuckle, highbush cranberry, blackhaw, shadbush (serviceberry), spindletree (euonymus), winged burning-bush (euonymus), French lilac (common), mockorange.	White pine, red pine, Norway spruce, hemlock (Canadian), black locust, tulip-poplar, blackgum, honeylocust (thornless), mountainash, Norway maple, ginko (maidenhair), white birch, flowering dogwood, basswood, redbud, cornelian cherry (dogwood), spindletree (euonymus), winged burning-bush (euonymus), flowering crabapple, hawthorne (Washington), pachysandra (spurge).	Hemlock (Canadian), black locust, mountainash, Norway maple, white birch, flowering dogwood, basswood, redbud, autumn-olive, Amur honeysuckle, highbush cranberry, blackhaw, mapleleaf (viburnum), shadbush (serviceberry), cornelian cherry (dogwood), spindletree (euonymus), winged burning-bush (euonymus), flowering crabapple, hawthorne (Washington), mockorange, coralberry.
White pine, jack pine, Austrian pine, Virginia pine, forsythia, hazelnut, lilac, scarlet oak, Russian-olive, autumn-olive, blackhaw, shadbush (serviceberry), staghorn sumac, fragrant sumac, flowering quince.	Red pine, Austrian pine, scarlet oak, honey locust (thornless), Russian-olive, staghorn sumac, fragrant sumac, flowering quince.	Scarlet oak, Virginia pine, jack pine, Austrian pine, Russian-olive, autumn-olive, blackhaw shadbush (serviceberry), hazelnut filbert), staghorn sumac, fragrant sumac, flowering dogwood, flowering quince.
White pine, jack pine, Austrian pine, forsythia, hazelnut, lilac, tamarisk, privet (Regels).	White pine, jack pine, Austrian pine, black locust, scarlet oak, blackgum.	Black locust, scarlet oak, blackgum, forsythia, hazelnut, privet (Regels), Jersey-tea.

of a given soil, while important, is only one of the criteria considered. Location, land value, esthetic value, and population density should also be considered. Some soil limitations can be modified or removed. For this reason some soils rated *severe* can be used, especially where good sites are scarce.

This section does not include soil interpretations for cottage foundations and sites. For such interpretations, see the ratings for dwellings in the section "Town and Country Planning."

Formation and Classification of Soils

In this section, the factors that have affected the formation of soils in Noble County are described and the processes of soil formation are explained. The current system of soil classification is explained, and the soils are assigned to the higher categories of this system. Laboratory data pertaining to the physical properties and reaction of selected soils are also provided.

Factors of Soil Formation

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have been active.

Climate and plant and animal life, mainly plants, are active in soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The

TABLE 10.—*Degree and kind of limitation*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. fully the instructions for referring to other series

Soil series and map symbols	Camp areas	Picnic areas
Adrian: Ad, Am	Severe: very poorly drained; organic soil; subject to ponding.	Severe: very poorly drained; organic soil; subject to ponding.
Aubbeenaubbee: Au	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained
Blount:		
BlA	Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained
BlB2	Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained
Boyer:		
BoB	Moderate: somewhat sandy	Moderate: somewhat sandy
BoC	Moderate: somewhat sandy; slope hinders use.	Moderate: somewhat sandy; slope hinders use.
BoD2	Severe: slope severely hinders use	Severe: slope severely hinders use
Brady: Br	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained
Brookston: Bx	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Casco: CcC3	Moderate: slope hinders use; somewhat clayey and gravelly.	Moderate: slope hinders use; somewhat clayey and gravelly.
Chelsea:		
ChB	Moderate: sandy	Moderate: sandy
ChC	Moderate: sandy; slope hinders use	Moderate: sandy; slope hinders use
Crosier: CrA	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained
Edwards: Ed, Em	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.
*Fox:		
FoA	Slight	Slight
FoB	Slight	Slight
FoC2	Moderate: slope hinders use	Moderate: slope hinders use
FsD2 For Casco part, see Casco series.	Severe: slope severely hinders use	Severe: slope severely hinders use
FsE2 For Casco part, see Casco series.	Severe: slope severely hinders use	Severe: slope severely hinders use
Fulton: Fu	Severe: somewhat poorly drained; very slow permeability.	Moderate: somewhat poorly drained
Gilford: Gf	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Haskins: HaA	Moderate: somewhat poorly drained; slow or very slow permeability.	Moderate: somewhat poorly drained
Homer: Hh	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained
Houghton: Hm, Ho	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.
Lake borders: La. Material too variable to be rated.		
Marl beds: Ma	Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; subject to ponding.

for recreational facilities

The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow care-that appear in the first column of this table]

Playgrounds	Paths and trails	Golf course fairways
Severe: very poorly drained; organic soil; subject to ponding.	Severe: very poorly drained; organic soil; subject to ponding.	Severe: very poorly drained; organic soil; subject to ponding; very poor trafficability.
Moderate: somewhat poorly drained	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained.
Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained	Severe: slow permeability.
Moderate: somewhat poorly drained; slow permeability; slope hinders use.	Moderate: somewhat poorly drained	Severe: somewhat poorly drained; slow permeability.
Moderate: somewhat sandy; slope hinders use.	Moderate: somewhat sandy	Moderate: somewhat sandy.
Severe: slope severely hinders use	Moderate: somewhat sandy	Moderate: somewhat sandy, slope hinders use.
Severe: slope severely hinders use	Moderate: somewhat sandy; slope hinders use.	Severe: slope hinders use.
Moderate: somewhat poorly drained	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained.
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table; slow permeability.
Severe: slope hinders use; somewhat gravelly.	Moderate: somewhat clayey and gravelly.	Moderate to severe: slope hinders use; somewhat clayey and gravelly.
Severe: sandy; slope hinders use	Moderate: sandy	Moderate: sandy; subject to soil blowing; droughty.
Severe: sandy; slope severely hinders use.	Moderate: sandy	Moderate: sandy; subject to soil blowing; droughty; slope hinders use.
Moderate: somewhat poorly drained	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained.
Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding; very poor trafficability.
Slight	Slight	Slight.
Moderate: slope hinders use	Slight	Slight.
Severe: slope severely hinders use	Slight	Moderate: slope hinders use.
Severe: slope severely hinders use	Moderate: slope hinders use	Severe: slope hinders use.
Severe: slope severely hinders use	Moderate: slope severely hinders use	Severe: slope severely hinders use.
Severe: very slow permeability; somewhat poorly drained.	Moderate: somewhat poorly drained	Severe: very slow permeability.
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Moderate: somewhat poorly drained; slow or very slow permeability.	Moderate: somewhat poorly drained	Severe: slow or very slow permeability.
Moderate: somewhat poorly drained	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained.
Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding; very poor trafficabiilty.
Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; subject to ponding.

TABLE 10.—*Degree and kind of limitation*

Soil series and map symbols	Camp areas	Picnic areas
Marsh: Mb. Material too variable to be rated.		
Martinsville: MdB	Slight	Slight
Metea: MeB	Moderate: somewhat sandy	Moderate: somewhat sandy
Miami:		
MfB2	Slight	Slight
MfC2	Moderate: slope hinders use	Moderate: slope hinders use
MfD2, MfE2	Severe: slope severely hinders use	Severe: slope severely hinders use
MgC3	Moderate: slope hinders use; somewhat clayey.	Moderate: slope hinders use; somwhat clayey.
MgD3	Severe: slope severely hinders use	Severe: slope severely hinders use
MhA	Slight	Slight
MhB2	Slight	Slight
Milford: Mn	Severe: poorly drained; seasonal high water table.	Severe: poorly drained; seasonal high water table.
*Morley:		
MrB2	Moderate: slow permeability	Slight
MrC2, MuC2	Moderate: slope hinders use; slow permeability.	Moderate: slope hinders use
For Miami and Rawson parts of MuC2, see Miami and Rawson series respectively.		
MrD2	Severe: slope severely hinders use	Severe: slope severely hinders use
MsC3	Moderate: slope hinders use; somewhat clayey; slow permeability.	Moderate: slope hinders use; somewhat clayey.
MsD3	Severe: slope severely hinders use	Severe: slope severely hinders use
MtE	Severe: slope severely hinders use	Severe: slope severely hinders use
Oshtemo:		
OsB	Moderate: somewhat sandy	Moderate: somewhat sandy
OsC	Moderate: somewhat sandy; slope hinders use.	Moderate: somewhat sandy; slope hinders use.
OtA	Slight	Slight
Palms: Pb	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.
Parr: PdA	Slight	Slight
Pewamo: Pe	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
*Rawson:		
RbA	Slight	Slight
RaC2	Moderate: slope hinders use	Moderate: slope hinders use
RaB, RbB, RdB2	Slight	Slight
For Morley and Miami parts of RdB2, see Morley and Miami series respectively.		

for recreational facilities—Continued

Playgrounds	Paths and trails	Golf course fairways
Moderate: slope hinders use	Slight	Slight.
Moderate: somewhat sandy; slope hinders use.	Moderate: somewhat sandy	Moderate: somewhat sandy.
Moderate: slope hinders use	Slight	Slight.
Severe: slope severely hinders use	Slight	Moderate: slope hinders use.
Severe: slope severely hinders use	Moderate: slope hinders use	Severe: slope severely hinders use.
Severe: slope severely hinders use; somewhat clayey.	Moderate: somewhat clayey	Moderate: somewhat clayey; slope hinders use.
Severe: slope severely hinders use; somewhat clayey.	Moderate: somewhat clayey; slope hinders use.	Severe: slope hinders use.
Slight	Slight	Slight.
Moderate: slope hinders use	Slight	Slight.
Severe: poorly drained; seasonal high water table.	Severe: poorly drained; seasonal high water table.	Severe: poorly drained; seasonal high water table; moderately slow permeability.
Moderate: slope hinders use	Slight	Severe: slow permeability.
Severe: slope severely hinders use	Slight	Severe: slow permeability; slope hinders use.
Severe: slope severely hinders use	Moderate: slope hinders use	Severe: slow permeability; slope hinders use.
Severe: slope severely hinders use; somewhat clayey.	Moderate: somewhat clayey	Severe: slow permeability; somewhat clayey; slope hinders use.
Severe: slope severely hinders use; somewhat clayey.	Moderate: somewhat clayey; slope hinders use.	Severe: slow permeability; slope hinders use; somewhat clayey.
Severe: slope severely hinders use; somewhat clayey.	Moderate: somewhat clayey; slope hinders use.	Severe: slope severely hinders use; somewhat clayey; slow permeability.
Moderate: slope hinders use; somewhat sandy.	Moderate: somewhat sandy	Moderate: somewhat sandy.
Severe: slope severely hinders use; somewhat sandy.	Moderate: somewhat sandy	Moderate: somewhat sandy; slope hinders use.
Slight	Slight	Slight.
Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding; poor trafficability.
Slight	Slight	Slight.
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Slight	Slight	Slight.
Severe: slope severely hinders use	Slight	Moderate: slope hinders use.
Moderate: slope hinders use	Slight	Slight.

TABLE 10.—*Degree and kind of limitation*

Soil series and map symbols	Camp areas	Picnic areas
Rensselaer: Re	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Riddles:		
RsA	Slight	Slight
RsB	Slight	Slight
RsC2	Moderate: slope hinders use	Moderate: slope hinders use
RsD2	Severe: slope severely hinders use	Severe: slope severely hinders use
Sebewa: Se	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Shoals: Sh	Severe: subject to occasional flooding	Moderate: subject to occasional flooding; somewhat poorly drained.
Toledo: To	Severe: very poorly drained; very slow permeability; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Wallkill: Wa	Severe: very poorly drained soil; mineral material over organic material; subject to ponding.	Severe: very poorly drained; mineral material over organic material; subject to ponding.
Warsaw: WrA	Slight	Slight
Washtenaw: Ws	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Whitaker: Wt	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained

Figure 16.—Rawson-Morley-Miami loams, 2 to 6 percent slopes, eroded, occupy sloping areas of this golf course. Milford silty clay loam is in the depressions.

for recreational facilities—Continued

Playgrounds	Paths and trails	Golf course fairways
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Slight	Slight	Slight.
Moderate: slope hinders use	Slight	Slight.
Severe: slope severely hinders use	Slight	Moderate: slope hinders use.
Severe: slope severely hinders use	Moderate: Slope severely hinders use	
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Moderate: subject to occasional flooding; somewhat poorly drained.	Moderate: subject to occasional flooding; somewhat poorly drained.	Moderate: subject to occasional flooding; somewhat poorly drained.
Severe: very poorly drained; very slow permeability.	Severe: very poorly drained	Severe: very poorly drained; seasonal high water table; very slow permeability.
Severe: very poorly drained; mineral material over organic material; subject to ponding.	Severe: very poorly drained; mineral material over organic material; subject to ponding.	Severe: very poorly drained; mineral material over organic material; subject to ponding.
Slight	Slight	Slight.
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table.
Moderate: somewhat poorly drained	Moderate: somewhat poorly drained	Moderate: somewhat poorly drained.

parent material also affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is always required for differentiation of horizons. Generally, a long time is required for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent material

The soils of Noble County formed in glacial till, glacial outwash, alluvium, and organic material. The county was covered several times by glacial ice sheets similar to the one now covering most of Greenland. These glaciers carried large amounts of glacial till and outwash, which are collectively called glacial drift, for long distances. The glacial drift in Noble County ranges in thickness from about 200 feet in the southwestern part of the county to more than 450 feet in the northeastern part (*14*).

Glacial till is unsorted material deposited by glaciers. A typical particle-size distribution for a soil formed in glacial till is illustrated by the data for the C horizon of Crosier soils in the table of physical and chemical properties under the heading "Laboratory Data." The glacial till in the northern and western part of the county is mostly part of the Packerton Morainic System. Crosier, Brookston, and Riddles soils formed in this medium textured glacial till. In some areas, the till has been covered with deposits of windblown sandy material of variable thickness. Chelsea and Metea soils formed in these sandy areas. The glacial till in the southeastern part of the county is moderately fine textured and is part of the Salamonie Moraine. The moderately fine textured glacial till in Green, Jefferson, Allen, and Wayne Townships is part of the Mississinewa Moraine System. Morley, Blount, Pewamo, and Rawson soils are in this area.

Glacial outwash is assorted soil material deposited by melt water from a glacier. The IIC horizon of Fox sandy loam shows the particle-size distribution of glacial outwash. During warm periods, melt water formed rivers that were several miles wide in places. Streams of melt water were also on, in, or under the glacial ice. This water-sorted material is mostly stratified sand and gravelly sand. It was laid down by moving water in streams.

Outwash plains are common in the northern and western parts of the county along the Elkhart River and Solomon Creek. Fox, Homer, Sebewa, and Oshtemo soils, which formed in loamy outwash over stratified sand and gravelly sand, are common in these areas. Fox and Oshtemo soils formed on knolls and ridges of sandy and gravelly outwash. In a few areas, sandy outwash has been reworked by wind. Chelsea soils formed in these areas. Silt and clay settled out of still water in lakes to form lacustrine deposits. Milford, Fulton, and Toledo soils formed in these deposits. The particle-size data for Milford soils in the physical and chemical properties table show that silt and clay make up most of the soil material.

Alluvial material is along streams that flood. These areas receive fresh deposits of alluvium during floods.

Most areas are along Little Cedar Creek and its tributaries. Shoals soils formed in these areas.

Organic material is partly decomposed remains of reeds, cattails, sedges, and water-tolerant trees and shrubs. They are in deep depressional areas that once were shallow lakes. The largest areas are near lakes and streams. Houghton muck is common in these areas.

Climate

Climate affects the formation of soils through the action of rainfall, temperature changes, and wind. The climate of Noble County is characterized by hot summers and humid, cold winters. The precipitation averages about 34 inches a year. It is fairly well distributed throughout the year, but it is slightly greater in spring. The climate is fairly uniform throughout the county, and differences among the soils cannot be attributed to climate.

Runoff received as rainfall or melting snow moves across the soils and through drainageways. It picks up soil material from higher elevations and deposits it in lower areas. Shoals soils formed in water-moved sediment. Flowing water breaks larger soil particles into smaller ones.

Temperature fluctuations and alternate cycles of freezing and thawing break down particles of soil material. Summer heat speeds up chemical weathering processes and the activity of living organisms, whereas winter slows them down.

Wind transfers soil material from one place to another. Particles of soil material are broken apart by abrasion as they are moved about by wind. Chelsea soils formed in windborne material.

Climate affects the processes of soil formation. Water percolating through the soil moves fine particles of clay from the surface layer to the subsoil. Percolating water also dissolves minerals and moves them through the soil.

Climate indirectly affects soil formation by its influence on plant and animal life. Wet, cool conditions favor the production and accumulation of organic matter. The climate of Noble County in recent times has favored the growth of hardwood trees, which affects the kind of soil that forms.

Plant and animal life

Plants, small animals, and micro-organisms are active in soil formation. Organic material is produced by plants, which absorb nutrients from the lower part of the soil. When the plants die and decay, some nutrients are left on or near the surface. Small burrowing animals, earthworms, bacteria, and fungi mix the organic material into the soil and decompose it into humus.

Most of the soils of Noble County formed under a native vegetation of deciduous hardwoods. In an area north of Ligonier, they formed under prairie grasses. The vegetation in marshes consisted of reeds, sedges, cattails, and water-tolerant trees and shrubs.

Forest vegetation adds organic matter on the surface mainly as leaf litter and dying trees. The dark-colored, natural surface layer is only a few inches thick. In well drained areas, oak, hickory, poplar, walnut, maple, and elm are dominant. Miami and Fox soils formed under deciduous hardwoods.

The forest in poorly drained areas consists mainly of maple, beech, sycamore, and white ash. In these areas, a deep, dark-colored surface layer formed because organic matter was preserved and mixed with mineral material when trees were uprooted by the wind or when soil material washed in from higher areas.

Grass incorporates a large amount of organic matter into a dark surface layer 8 to 12 inches thick. Warsaw soils formed under prairie vegetation.

Marsh areas are common near the Elkhart River and around lakes throughout the county. The vegetation in marshes adds large amounts of organic matter to the soil. This organic matter decomposes slowly because wetness slows the activity of small animals and micro-organisms. Partly decomposed organic material accumulates in these areas as thick deposits of muck and peat. Houghton muck formed under marsh vegetation.

Man has changed the soils by clearing the forests, plowing the prairie grassland, and draining and cultivating the marshes. Sloping areas become more susceptible to erosion when the natural cover is removed and the soil is cultivated. In eroded areas, the organic-matter content is lower and the natural, friable surface layer is replaced by a hard and cloddy layer. Soil blowing has removed much of the surface layer from sandy soils in places. Man also drained the wet depressional soils and improved their aeration. Drainage causes more rapid oxidation of organic matter. The marsh areas are greatly affected by drainage. Subsidence and oxidation of muck have lowered the surface several feet in places.

Washtenaw and Wallkill soils have been forming since man cleared the land. The original surface layer has been covered by recent alluvium. In some places, such as gravel pits, man's activities have greatly changed the soils.

Relief

Relief influences the formation of the soils through its effect on drainage and runoff. The relief in Noble County is predominantly gently sloping or moderately sloping, but some areas are nearly level or steep.

Runoff is generally more rapid on steep slopes and more erosion has occurred. Steep soils are not so distinctly formed as nearly level soils. Soil horizons are thinner and not so strongly leached of carbonates, and plant growth is slower. Because runoff is rapid on steep soils, less water percolates through the soils and the soil-forming processes are slower.

Internal drainage has greatly affected the formation of the soils of the county. Different kinds of soil form from the same kind of parent material. For example, Miami and Crosier soils both formed in medium textured glacial till. Well drained Miami soils formed mainly on sloping knolls. They have a moderately dark surface layer and a brownish subsoil. Somewhat poorly drained Crosier soils formed mainly on nearly level flats and along drainageways. They have a moderately dark surface layer and a grayish, mottled subsoil.

Time

Time is necessary for the formation of soil from

parent material. The length of time required depends on the combined action of the other factors of soil formation.

Alluvial soils are young and show little evidence of soil formation because new material is periodically added. Shoals soils are an example.

Some steep soils are young because erosion removes the material as fast as it forms.

Mature soils have well developed A and B horizons. The leaching of carbonates and the translocation of silicate clay material are processes that require considerable time and are associated with mature soils. Miami, Crosier, and Fox soils are mature.

Processes of Soil Formation

The differentiation of horizons in the soils of the county involved several processes. Most important are the accumulation of organic matter, the leaching of carbonates and salts more soluble than calcium carbonate, the translocation of silicate clay minerals from one horizon to another, and the reduction and transfer of iron. In all the soils, most of these processes have taken place, but the effect varies from soil to soil.

In the soils of Noble County, organic matter has accumulated in the upper layers and, thus, an A1 horizon has formed. In some of the soils this horizon cannot be identified because it has been mostly or entirely lost through erosion or it has been mixed with the subsoil by cultivation. Much of the organic matter is humus. The organic-matter content is low in severely eroded Morley soils, somewhat high in Pewamo soils, and very high in Houghton soils.

Leaching of carbonates and other salts has taken place in almost all the soils of the county. Well drained soils, such as Miami soils, are generally completely leached, but leaching is slow in the poorly drained or wet soils, such as Brookston soils, because of a seasonal high water table. A comparison between the low pH values of the B horizon in Fox, Homer, and other soils and the high pH values of the C horizon shows how lime has been leached from the soils. Leaching has had little effect on the alluvial soils of the Shoals series because these soils have not been in place long enough. Leaching precedes and permits the translocation of silicate minerals in most falls.

The translocation of silicate clay minerals influenced the formation of horizons in most soils of the county. The clay moved down from the A horizon and accumulated in the B horizon, for example, in Crosier soils. Shoals soils do not show evidence of translocated clay minerals.

In the formation of silicate clays, some iron is generally freed as hydrated oxide, which is more or less strongly red in color depending on the degree of hydration. Morley, Miami, and Fox are examples of soils having iron freed as hydrated oxide.

Most of the soils formed through the process of podzolization, which is most active under forest vegetation and in a somewhat cool, humid climate. In this process, percolating water carries the clay down from the upper layers and deposits it as films along channels or on the faces of peds in the B horizon. Organic acids formed by the decomposition of organic matter in the surface layer dissolve manganese and iron as the solution moves down. The result is an A2 horizon that is lighter in color than the rest of the solum because iron and manganese compounds originally were contained in dark colored minerals. Morley, Miami, Blount, and Crosier soils are affected by podzolization.

Gleying, or the reduction and transfer of iron, has taken place in Pewamo and Blount soils and in other somewhat poorly drained and very poorly drained soils. It has also taken place to some extent in the deep horizons of Morley soils and other well drained and moderately well drained soils. Gray colors in the deep horizons of poorly drained soils, such as Pewamo and Milford soils, indicate the reduction of iron oxides. This reduction is commonly accompanied by some transfer of iron. Yellowish red, yellowish brown, or brown mottles and concretions in the deep horizons of many soils indicate segregation of iron. After it has been reduced, the iron may be removed completely from the horizon, or even from the profile, but in the soils in this county, it is more commonly moved only a short distance within the horizon or into a nearby horizon.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*13*). Because this system is under continual study, readers interested in developments of the current system should search the latest literature available (*10*).

The current system of classification has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. In this system, the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together. The same property or subdivisions of this property may be used in several different categories. In table 11, the soils of Noble County are placed in categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad, climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and

TABLE 11.—*Classification of the soil*

Series	Family	Subgroup	Order
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic.	Terric Medisaprists	Histosols.
Aubbeenaubbee	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Blount	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Brady	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Brookston	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Casco	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols.
Chelsea	Mixed, mesic	Alfic Udipsamments	Entisols.
Crosier	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Edwards	Marly, euic, mesic	Limnic Medisaprists	Histosols.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols.
Fulton	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Gilford	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Haskins	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Homer	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Aeric Ochraqualfs	Alfisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Martinsville	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Metea [1]	Loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Milford	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Morley	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Oshtemo	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Parr	Fine-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Pewamo	Fine, mixed, mesic	Typic Argiaquolls	Mollisols.
Rawson	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Rensselaer	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Riddles	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Argiaquolls	Mollisols.
Shoals	Fine-loamy, mixed, nonacid, mesic.	Aeric Fluvaquents	Entisols.
Toledo	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Wallkill	Fine-loamy, mixed, nonacid, mesic.	Thapto-Histic Fluvaquents	Entisols.
Warsaw	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Argiudolls	Mollisols.
Washtenaw	Fine-loamy, mixed, nonacid, mesic.	Typic Haplaquents	Entisols.
Whitaker	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.

[1] Metea soils in this county differ from Metea soils in other counties in that the upper part of the subsoil contains a few thin loamy sand lamellae.

Vertisols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders that are based on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than the orders. The soil properties used to separate suborders are mainly the presence of absence of a water table at a shallow depth; soil differences resulting from climate; accumulation of clay, iron, or organic carbon in the upper part of the solum; cracking of soils caused by a decrease in moisture; and fine stratification. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquoll* (*Aqu*, meaning water or wet, and *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons considered are those in which clay, carbonates, and other constituents have accumulated or have been removed and those having pans that interfere with growth of roots, movement of water, or both. Some features considered are acidity, climate, chemical composition, and color. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquoll (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *oll*, from Mollisols).

SUBGROUP. Each great group is divided into subgroups, one representing the central, or typic, segment of the group, and others called intergrades, which have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups have soil properties unlike those of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquolls (a typical Haplaquoll).

FAMILY. Families are established within a sub-

group primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, temperature, permeability, depth, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for the soil properties, such as texture and mineralogy, that are used as family differentiae (see table 11). An example is the coarse-loamy mixed, mesic family of Typic Haplaquolls. Particle-size distribution data, shown in the laboratory data table in this survey, have been used to classify soils in the proper family.

Laboratory Data[5]

The physical and chemical properties of six selected soils in Noble County are shown in table 12. The soils sampled are the Brady, Casco, Crosier, Fox, Homer, and Milford soils. They were sampled between 1969 and 1971. The analysis is of the profiles described in the section "Descriptions of the Soils."

Methods of sampling and analysis.—Large samples were taken from carefully selected pits. Samples were thoroughly mixed, air dried, and divided to obtain a sample for testing of approximately 1 pint. Where the soil contained material more than 2 millimeters in diameter, material more than three-quarters of an inch in diameter was sieved out and an estimate, by volume, made and recorded. The material less than three-quarters of an inch in diameter was sieved to obtain two samples: material more than 2 millimeters and material less than 2 millimeters. These samples were weighed in the laboratory to obtain the percent of material 2 millimeters to three-quarters of an inch in diameter. All samples were granulated while moist in the field by rubbing through a ¼-inch screen and were air dried.

The textural class and pH values as computed by laboratory analysis may differ from those in the profile descriptions.

To obtain particle-size distribution, organic matter was destroyed if the organic carbon content was more than 2 percent. Clay content was determined after dispersion by a calgon solution and overnight shaking. Following the clay determination, the suspension was passed through a number 50 sieve and the sand fraction was collected, dried, and weighed. Silt content was determined by adding the percentage of clay and sand and subtracting from 100.

Oxidizable organic carbon was determined by the Walkley-Black method, which involved oxidation of organic carbon by potassium dichromate and sulfuric acid.

The pH was determined by using a glass electrode pH meter on a 1:1 soil-water suspension.

Extractable phosphorus was determined by the Bray P-1 test. The soil was extracted with a 0.025N HCL and 0.03N NH_4F solution, and phosphorus was determined by the molybdophosphoric blue colorimetric method.

Extractable potassium was extracted with neutral 1N ammonium acetate and determined by using an atomic absorption spectrophotometer.

The phosphorus and potassium determinations were made by the routine tests for available nutrients and are reported as pounds per acre. It was assumed that the plow layer for an acre of soil weighs 2,000,000 pounds.

[5] DR. DONALD P. FRANZMIER, associate professor of agronomy, Purdue University, helped prepare this section.

Environmental Factors Affecting Soil Use

The first settlement in Noble County was in 1827, about 3.5 miles southeast of Wolf Lake. The county was organized in 1836. Sparta was the first county seat. The county seat was moved to Augusta, about 2 miles west of Albion, then to Port Mitchell Lake, and finally to Albion in 1856. The population was 2,702 in 1840 and 31,382 in 1970. Kendallville, Ligonier, and Albion are the main industrial and trade centers.

The paragraphs that follow describe the natural features in Noble County that have an effect on soil use. These features are relief, drainage, and climate. Also described are cultural features that have some effect on soil use. These features are transportation facilities and manufacturing and farming.

Relief and Drainage

Noble County is within the Steuben morainal lake area of the northern lake and moraine physiographic region (*14*).

The relief ranges from nearly level to steep; it is predominantly gently sloping or moderately sloping. The landforms are mainly the result of glaciation. In the northwestern part of the county are mostly nearly level or gently sloping outwash plains. The more sloping areas are around numerous potholes and lakes and along drainageways. The largest area of strongly sloping to steep soils is in Green Township and extends northwest into parts of York, Perry, and Elkhart Townships. The rest of the county is mostly gently sloping or moderately sloping areas that have many small, nearly level flats or depressions.

The elevation of the county ranges from 1,060 feet above sea level in the north-central part to less than 850 feet in the southeastern part. Most of the county is drained by the Elkhart River and its tributaries. The Elkhart River is part of the St. Joseph River Watershed, which drains mostly into Lake Michigan. In the extreme southwestern part, the watershed is drained by tributaries of the Tippecanoe River, which is part of the Mississippi River Watershed. In the southeastern and east-central parts, it is drained by Cedar Creek, a tributary of the Maumee River that flows into Lake Erie.

TABLE 12.—*Physical and chemical*

[Analyses of particle-size and organic carbon content by soil scientists in the Purdue University Agronomy Laboratory; deter-

Soil	Depth	Sample number	Horizon	Particle-size distribution of less than 2 millimeter material			
				Sand			
				Very coarse and coarse 2–0.5 mm	Medium 0.5–0.25 mm	Fine 0.25–0.10 mm	Very fine 0.10–0.05 mm
	In			*Pct*	*Pct*	*Pct*	*Pct*
Brady sandy loam	0–7	S70IN57–3–1	Ap	14	21	24	6
	7–9	S70IN57–3–2	A12	14	21	24	5
	9–17	S70IN57–3–3	B1	12	22	24	5
	17–31	S70IN57–3–4	B21	18	25	27	4
	[1] 17–31	S70IN57–3–5	B21t	17	24	22	3
	31–53	S70IN57–3–6	B22	14	25	42	5
	[1] 31–53	S70IN57–3–7	B22t	9	22	45	7
	53–72	S70IN57–3–8	IIC	10	26	43	9
Casco sandy clay loam	0–7	S69IN57–2–1	Ap	23	17	18	8
	7–15	S69IN57–2–2	B21t	51	6	5	2
	15–18	S69IN57–2–3	B22t	71	9	2	1
	18–30	S69IN57–2–4	IIC	74	6	5	3
Crosier loam	0–10	S71IN57–1–1	Ap	5	12	24	13
	10–14	S71IN57–1–2	B1	3	8	17	11
	14–22	S71IN57–1–3	B21t	5	10	18	9
	22–35	S71IN57–1–4	B22t	4	10	20	1
	35–60	S71IN57–1–5	C	13	15	20	11
Fox sandy loam	0–9	S69IN57–1–1	Ap	25	21	19	5
	9–14	S69IN57–1–2	B1	24	21	20	5
	14–27	S69IN57–1–3	B21t	24	21	16	3
	27–33	S69IN57–1–4	B22t	37	22	13	3
	33–35	S69IN57–1–5	B3t	61	17	4	1
	35–42	S69IN57–1–6	IIC	57	23	13	1
Homer loam	0–8	S70IN57–1–1	Ap	19	18	14	5
	8–10	S70IN57–1–2	A2	18	19	16	5
	10–18	S70IN57–1–3	B1t	13	14	13	5
	18–25	S70IN57–1–4	B21t	14	14	11	4
	25–34	S70IN57–1–5	B22t	34	14	10	3
	34–38	S70IN57–1–6	IIB3	46	29	10	2
	38–60	S70IN57–1–7	IIC	51	18	11	5
Milford silty clay loam	0–7	S69IN57–3–1	Ap	4	2	3	4
	7–11	S69IN57–3–2	A12	3	2	3	4
	11–16	S69IN57–3–3	B1g	2	2	3	4
	16–26	S69IN57–3–4	B21g	1	1	2	3
	26–33	S69IN57–3–5	B22g	1	1	3	6
	33–44	S69IN57–3–6	B23g	1	1	3	6
	44–49	S69IN57–3–7	B3	1	1	1	2
	49–63	S69IN57–3–8	C	11	15	15	5

[1] Horizon contains 4 inches of bands of sandy clay loam.

Climate [6]

Noble County has a continental climate somewhat modified by the Great Lakes. The climate results from the influence of cool Canadian air masses alternating with tropical air masses from the south to bring changes within days and variable seasons. The climate is excellent for farming.

Rainfall is generally adequate during the growing season. In mid-summer, however, evaporation exceeds rainfall for brief periods. As a result, lawns, pastures, and crops are adversely affected.

Weather changes come from the passing of weather fronts and associated centers of low and high air pressure. In general, a high brings lower temperatures, lower humidity, and sunny days. An approaching low brings increasing temperatures, increasing southerly winds, higher humidity, and rain. This activity is greatest in the spring and least late in summer and early in fall.

Temperatures in a 30-year period ranged from –23°

[6] By LAWRENCE A. SCHAAL, State climatologist, Department of Agronomy, Purdue University.

properties of selected soils

minations of pH, extractable P, and extractable K by Purdue Plant and Soil Analysis Laboratory. The symbol < means less than.]

Particle-size distribution of less than 2 millimeter material—continued		Fraction greater than 2 millimeters	Textural class	Organic carbon	pH of 1:1 soil:water solution	Extractable	
Silt 0.05–0.002 mm	Clay <0.002 mm					P	K
Pct	*Pct*	*Pct*		*Pct*		*Lb per acre*	*Lb per acre*
27	8	6	Sandy loam	1.45	7.0	156	165
32	4	9	Sandy loam	1.57	6.8	141	105
28	9	7	Sandy loam		6.7	208	90
19	7	5	Sandy loam		6.7	40	60
21	13	0	Sandy loam		6.6	22	90
7	7	5	Loamy sand		6.6	33	60
7	10	0	Loamy sand, sandy loam		6.5	33	75
8	4	3	Sand, loamy sand		6.5	21	30
16	18	3	Sandy loam, sandy clay loam	0.99	7.0	20	150
10	26	4	Sandy clay loam	0.58	6.6	5	180
5	12	12	Sandy loam		6.7	6	-105
9	3	8	Sand and gravelly sand		7.8	4	30
37	9	5	Sandy loam, loam		7.3	9	60
38	19	2	Loam		6.8	2	75
33	25	4	Loam		6.8	2	105
32	23	5	Loam		6.8	2	105
31	10	11	Sandy loam		8.1	1	75
24	6	14	Sandy loam	0.61	5.8	15	90
20	10	27	Gravelly sandy loam	< 0.1	5.8	12	90
12	24	30	Gravelly sandy clay loam		5.8	21	135
5	20	22	Gravelly sandy clay loam, gravelly sandy loam		5.7	28	120
8	9	7	Sandy loam		5.9	26	90
4	2	5	Sand and gravelly sand		7.8	10	30
34	10	10	Sandy loam	1.16	6.9	51	225
31	11	10	Sandy loam	1.51	7.0	60	300
41	14	12	Loam		5.3	3	90
34	23	18	Gravelly loam		5.4	2	165
14	25	25	Gravelly sandy clay loam		5.4	5	180
5	8	20	Gravelly loamy sand		7.7	11	75
12	3	30	Sand and gravelly sand		8.1	3	30
53	34	< 1	Silty clay loam	3.13	7.0	58	285
52	36	< 1	Silty clay loam	2.35	7.0	60	240
53	36	< 1	Silty clay loam	2.67	7.1	44	225
49	44	< 1	Silty clay	0.90	7.4	24	240
49	40	< 1	Silty clay loam, silty clay	0.44	7.1	30	270
44	45	< 1	Silty clay	0.64	7.3	48	255
55	40	< 1	Silty clay loam, silty clay		7.0	44	300
31	23	3	Loam		7.2	25	195

F. to 111°. Temperatures of 90° or higher occurred on an average of 19 days a year, and those continually below 32° occurred on an average of 47 days a year. The data in tables 13 and 14 come from a cooperative weather station of the National Weather Service located 5 miles east of Albion, which is a rural location considered climatologically representative of the county (*8*).

Average annual precipitation is evenly distributed throughout the year. Spring and early summer rain, however, generally exceeds precipitation in winter. Spring rain is considered reliable, insuring near maximum soil moisture as summer approaches and an excellent growing season. Sometimes wetness in spring delays planting. The least amount of precipitation generally occurs in February.

Following is the probability of unusually heavy rain, as indicated by a weather study of the area (*8*):

Frequency in 100 years	Inches in 1 hour	Inches in 6 hours	Inches in 12 hours
4	2.1	3.2	3.7
10	1.7	2.8	3.2
20	1.5	2.4	2.8

TABLE 13.—*Temperature and precipitation*

[Data from U.S. Weather Station 5 miles east of Albion; elevation 983 feet, for period 1941–1972]

Month	Temperature				Precipitation				
						One year in 10 will have—			
	Average daily maximum	Average daily minimum	Average monthly highest maximum	Average monthly lowest minimum	Average monthly total	Less than—	More than—	Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover of 1 inch or more
	°F	°F	°F	°F	Inches	Inches	Inches	Number	Inches
January	32	16	52	–6	2.0	0.5	4.0	16	2.8
February	35	18	54	–2	1.6	.4	2.8	14	2.9
March	45	26	68	7	2.2	.9	3.8	5	1.7
April	60	38	80	22	3.4	1.2	5.2	1	.5
May	70	47	85	31	3.5	2.1	4.7	0	0
June	80	57	91	42	4.0	1.7	6.4	0	0
July	86	58	92	49	3.9	1.6	6.4	0	0
August	82	59	91	45	3.0	1.4	5.3	0	0
September	76	52	87	35	2.8	.9	5.7	0	0
October	65	42	81	25	2.7	.7	5.1	0	0
November	48	31	68	14	2.7	1.1	4.1	2	1.0
December	35	20	57	0	2.2	.4	4.4	13	2.7
Year	59	39	[1] 95	[2] –9	34.0	25.2	42.2	51	2.6

[1] Average annual highest temperature.
[2] Average annual lowest temperature.

TABLE 14.—*Probabilities of last freezing temperature in spring and first in fall*

[Data recorded at U.S. Weather Station]

Probability	Dates for given probability and temperatures				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 30	April 10	April 24	May 3	May 21
2 years in 10 later than	March 25	April 5	April 18	April 29	May 16
5 years in 10 later than	March 14	March 24	April 6	April 20	May 7
Fall:					
1 year in 10 earlier than	November 11	November 1	October 24	October 11	September 25
2 years in 10 earlier than	November 17	November 6	October 28	October 16	September 30
5 years in 10 earlier than	November 29	November 18	November 7	October 27	October 11

Snowfall averages 27 inches a year. December, January, and February average 6 inches each. In 1948, December snowfall totaled 20 inches. In a recent 30-year period, the greatest daily snowfall was 8 inches on March 27, 1934. Snow generally protects winter grain from the cold air.

Cloudiness in Noble County can be indicated by that observed in nearby Allen County, where 181 days out of 365 are cloudy and 77 are clear (*3*). The sun is observed for 58 percent of daylight hours. This percent ranges from 37 in December to 72 in July and August.

Relative humidity at noon averages about 55 percent in summer and 65 percent in winter. On most nights, relative humidity increases to 95 to 100 percent. This increase is frequently accompanied by dew or frost.

Winds are most frequently from the southwest. During a few winter months, however, the dominant direction is northwest. The velocity of these winds averages 8 miles per hour in August and 12 miles per hour in March and April. Damaging winds originate from thunderstorms or tornadoes. In a 53-year period, only five tornadoes were reported. Thunderstorms occur about 46 days a year.

Transportation Facilities and Manufacturing

Noble County is crossed by two east-west railroads

and one north-south railroad, which serve the major towns. Federal Highways 6 and 33 and Indiana Highways 3, 5, 8, 9, and 205 traverse the county. Most of the county roads are paved, but a few are gravel. A small airport is located north of Kendallville.

Kendallville, Albion, and Ligonier are manufacturing centers. Industries include the manufacture of pumps, castings, electrical wiring, and plastic articles. Many small factories are located in towns and rural areas. Gravel and sand are obtained from numerous gravel pits for use in road building and construction.

Farming

The first crops grown by settlers in Noble County were wheat, barley, corn, and vegetables. Livestock was raised for food and for work animals. The settlers found a good source of wild grasses for hay for livestock on the marshlands.

The first areas cleared and cropped were the well drained uplands and outwash plains. Many early settlers were in Perry Township near Ligonier and in the prairies to the north. As the population increased, however, artificial drainage was gradually installed and many other sections were planted. Large areas of swamps adjacent to numerous lakes made transportation extremely difficult over parts of the county. Drainage was generally required to lower the water table throughout large areas. With the expansion of farming came improved methods of farming, including a more stabilized system of cropping (*12*).

The number of farms has decreased from 2,450 in 1920 to 1,517 in 1969, and the size of farms has increased from an average of 102.1 acres in 1920 to 150 acres in 1969. The number of cattle and hogs has increased, and the number of sheep has decreased.

Many small farms are owned and operated by part-time farmers who also have jobs in local industries. Also, many farms are operated by renters, many of whom cultivate large acreages on a sharecrop basis.

The acreage in corn and soybeans has increased, whereas that in small grain, including wheat, oats, and barley, has decreased. Potatoes and onions were once important in Noble County, but are presently grown on very few acres. Mint, which was formerly grown in many drained areas of muck, is now seldom grown. Corn is grown in these areas.

In many areas, formerly cultivated muck has subsided so much that drainage systems are inadequate. The vegetation is mostly water-tolerant sedges, grasses, and shrubs.

Many farms have become more specialized, and general farming has become less important. Cash-grain farming is becoming more common. The number of farms raising livestock has decreased, but the number of livestock on these farms has increased.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented. Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Depth, soil. Total depth of soil profile over bedrock or other strongly contrasting nonconforming rock material. Depth class limits used in describing soils in this survey and their depth are—

Shallow	20 inches or less
Moderately deep	20 to 40 inches
Deep	40 inches or more

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage, surface. Runoff, or surface flow, of water from an area.

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by streams and lakes associated with them.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Green manure (agronomy). A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soil.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal, lateral, medial, ground.

Mottled. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of fairly well decomposed organic material that is relatively high in mineral content, finely divided, and dark in color.

Mulch. A natural or artificially applied layer of plant residue or other material on the surface of the soil. Mulches are generally used to help conserve moisture, control temperature, prevent surface compaction or crusting, reduce runoff and erosion, improve soil structure, or control weeds. Common mulching materials are wood chips, plant residue, sawdust, or compost.

Natural soil drainage. Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Peat. Unconsolidated soil material, largely undecomposed organic matter, that has accumulated where there has been excess moisture.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in

size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degree of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called groundwater runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grained* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which the mapping unit belongs.

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group
			Symbol	Page	Symbol	Number
Ad	Adrian muck	12	Vw-3	56	4w23	1
Am	Adrian muck, drained	12	IVw-3	55	4w23	1
Au	Aubbeenaubbee fine sandy loam	13	IIw-11	51	3o5	2
B1A	Blount silt loam, 0 to 2 percent slopes	14	IIw-2	50	3o5	2
B1B2	Blount silt loam, 2 to 4 percent slopes, eroded	14	IIe-13	50	3o5	2
BoB	Boyer loamy sand, 2 to 6 percent slopes	14	IIIs-2	54	3s17	5
BoC	Boyer loamy sand, 6 to 12 percent slopes	15	IIIe-13	52	3s17	5
BoD2	Boyer loamy sand, 12 to 18 percent slopes, eroded	15	IVe-13	55	3s17	5
Br	Brady sandy loam	16	IIIw-4	53	3w20	2
Bx	Brookston silt loam	17	IIw-1	50	2w11	1
CcC3	Casco sandy clay loam, 8 to 15 percent slopes, severely eroded	17	VIe-3	56	3s17	5
ChB	Chelsea fine sand, 2 to 6 percent slopes	18	IIIs-1	54	3s17	5
ChC	Chelsea fine sand, 6 to 12 percent slopes	18	IIIs-12	54	3s17	5
CrA	Crosier loam, 0 to 2 percent slopes	19	IIw-2	50	3o5	2
Ed	Edwards muck	20	Vw-3	56	4w23	1
Em	Edwards muck, drained	20	IVw-3	55	4w23	1
FoA	Fox sandy loam, 0 to 2 percent slopes	20	IIs-2	52	2o15	4
FoB	Fox sandy loam, 2 to 6 percent slopes	21	IIe-2	49	2o15	4
FoC2	Fox sandy loam, 6 to 12 percent slopes, eroded	21	IIIe-13	52	2o15	4
FsD2	Fox-Casco sandy loams, 12 to 18 percent slopes, eroded	21	IVe-13	55	2o15	4
FsE2	Fox-Casco sandy loams, 18 to 25 percent slopes, eroded	22	VIe-3	56	2r2	4
Fu	Fulton silt loam	23	IIIw-6	53	3o5	2
Gf	Gilford sandy loam	23	IIw-4	50	4w21	1
HaA	Haskins loam, 0 to 2 percent slopes	24	IIw-2	50	3o5	2
Hh	Homer loam	25	IIw-6	51	3w20	2
Hm	Houghton muck	26	Vw-3	56	4w23	1
Ho	Houghton muck, drained	26	IIIw-8	53	4w23	1
La	Lake borders	27	------	--	----	---
Ma	Marl beds	27	VIw-1	56	----	---
Mb	Marsh	27	------	--	----	---
MdB	Martinsville fine sandy loam, 2 to 6 percent slopes	28	IIe-11	49	1o1	3
MeB	Metea loamy fine sand, 2 to 6 percent slopes	28	IIIe-13	52	2s15	4
MfB2	Miami loam, 2 to 6 percent slopes, eroded	29	IIe-1	49	1o1	3
MfC2	Miami loam, 6 to 12 percent slopes, eroded	29	IIIe-1	52	1o1	3
MfD2	Miami loam, 12 to 18 percent slopes, eroded	30	IVe-1	54	1o1	3
MfE2	Miami loam, 18 to 25 percent slopes, eroded	30	VIe-1	56	1r2	3
MgC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	30	IVe-1	54	1o1	3
MgD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	31	VIe-1	56	1o1	3
MhA	Miami loam, gravelly substratum, 0 to 2 percent slopes	31	I-1	48	1o1	3
MhB2	Miami loam, gravelly substratum, 2 to 6 percent slopes, eroded	31	IIe-1	49	1o1	3
Mn	Milford silty clay loam	32	IIw-1	50	2w11	1
MrB2	Morley silt loam, 2 to 6 percent slopes, eroded	33	IIe-6	49	1o1	3
MrC2	Morley silt loam, 6 to 12 percent slopes, eroded	33	IIIe-6	52	1o1	3
MrD2	Morley silt loam, 12 to 18 percent slopes, eroded	33	IVe-6	55	1o1	3
MsC3	Morley silty clay loam, 6 to 12 percent slopes, severely eroded	33	IVe-6	55	1o1	3
MsD3	Morley silty clay loam, 12 to 18 percent slopes, severely eroded	34	VIe-1	56	1o1	3
MtE	Morley soils, 18 to 25 percent slopes	34	VIe-1	56	1r2	3
MuC2	Morley, Miami, and Rawson loams, 6 to 12 percent slopes, eroded	34	IIIe-6	52	1o1	3
OsB	Oshtemo loamy sand, 2 to 6 percent slopes	35	IIIs-2	54	3s17	4
OsC	Oshtemo loamy sand, 6 to 12 percent slopes	35	IIIe-13	52	3s17	4
OtA	Oshtemo sandy loam, 0 to 2 percent slopes	35	IIIs-2	54	3s17	4

Map symbol	Mapping unit	Page	Capability unit		Woodland group	Tree and shrub group
			Symbol	Page	Symbol	Number
Pb	Palms muck, drained	36	IIw-10	51	4w23	1
PdA	Parr loam, 0 to 2 percent slopes	37	I-1	48	----	3
Pe	Pewamo silty clay loam	37	IIw-1	50	2w11	1
RaB	Rawson sandy loam, 2 to 6 percent slopes	38	IIe-5	49	1o1	3
RaC2	Rawson sandy loam, 6 to 12 percent slopes, eroded	38	IIIe-5	52	1o1	3
RbA	Rawson loam, 0 to 2 percent slopes	39	I-1	48	1o1	3
RbB	Rawson loam, 2 to 6 percent slopes	39	IIe-1	49	1o1	3
RdB2	Rawson, Morley, and Miami loams, 2 to 6 percent slopes, eroded	39	IIe-1	49	1o1	3
Re	Rensselaer loam	40	IIw-1	50	2w1I	1
RsA	Riddles sandy loam, 0 to 2 percent slopes	41	I-3	48	1o1	3
RsB	Riddles sandy loam, 2 to 6 percent slopes	41	IIe-5	49	1o1	3
RsC2	Riddles sandy loam, 6 to 12 percent slopes, eroded	41	IIIe-5	52	1o1	3
RsD2	Riddles sandy loam, 12 to 18 percent slopes, eroded	41	IVe-5	55	1o1	3
Se	Sebewa loam	42	IIw-4	50	2w11	1
Sh	Shoals silt loam	43	IIw-7	51	2o13	2
To	Toledo silty clay loam	44	IIw-1	50	2w11	1
Wa	Wallkill silt loam	44	IIIw-11	54	4w23	1
WrA	Warsaw loam, 0 to 2 percent slopes	45	IIs-2	52	----	4
Ws	Washtenaw silt loam	46	IIw-1	50	2w11	1
Wt	Whitaker loam	46	IIw-2	50	3o5	2

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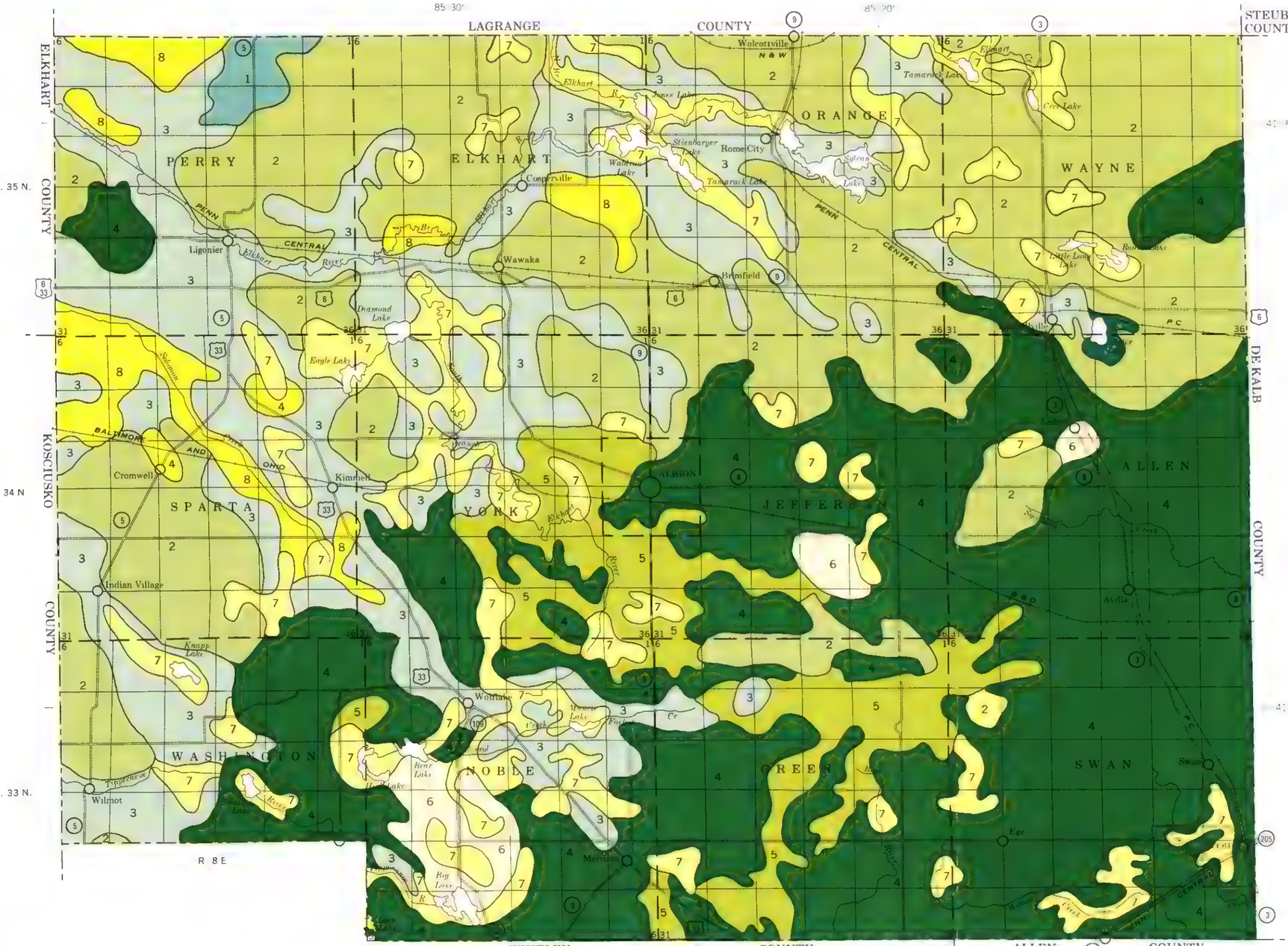


N

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

NOBLE COUNTY, INDIANA

Scale 1:126,720

1 0 1 2 3 4 Miles

SOIL ASSOCIATIONS

MODERATELY DEEP OR DEEP, WELL DRAINED TO VERY POORLY DRAINED, NEARLY LEVEL TO MODERATELY STEEP MINERAL SOILS THAT HAVE A MODERATELY COARSE TEXTURED TO FINE TEXTURED SUBSOIL; ON UPLANDS OR OUTWASH PLAINS

1 — Warsaw-Parr association: Well drained, nearly level soils that have a dominantly moderately fine textured subsoil and are moderately deep and deep over sand and gravel; on outwash plains and uplands

2 — Miami-Riddles-Brookston association: Well drained and very poorly drained, nearly level to moderately steep, deep soils that have a moderately fine textured subsoil; on uplands

3 — Fox-Oshtemo association: Well drained, nearly level to moderately steep soils that have a moderately coarse textured to moderately fine textured subsoil and are moderately deep and deep over sand and gravel; on outwash plains and uplands

4 — Morley-Blount association: Well drained to somewhat poorly drained, nearly level to moderately sloping, deep soils that have a fine textured and moderately fine textured subsoil; on uplands

5 — Morley-Miami association: Well drained or moderately well drained, moderately sloping to moderately steep, deep soils that have a moderately fine textured or fine textured subsoil; on uplands

MODERATELY DEEP OR DEEP, SOMEWHAT POORLY DRAINED TO VERY POORLY DRAINED, NEARLY LEVEL MINERAL AND ORGANIC SOILS THAT HAVE A MODERATELY FINE TEXTURED OR FINE TEXTURED SUBSOIL OR ORGANIC MATERIAL: ON UPLANDS OR OUTWASH PLAINS

6 — Haskins-Toledo association: Somewhat poorly drained and very poorly drained, nearly level, deep soils that have a moderately fine textured or fine textured subsoil; on outwash plains and uplands

7 — Houghton-Edwards-Adrian association: Very poorly drained, nearly level mucks that are deep or moderately deep over marl or sand and gravel; in depressions on uplands or outwash plains

8 — Homer-Sebewa association: Somewhat poorly drained and very poorly drained, nearly level soils that have a moderately fine textured subsoil and are moderately deep over sand and gravel; on outwash plains

Compiled 1976

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

INDEX TO MAP SHEETS
NOBLE COUNTY, INDIANA

Scale 1:126,720

1 0 1 2 3 4 Miles

N

85°30′ 85°20′ 41°30′ 41°20′

T. 35 N. T. 34 N. T 33 N

R. 8 E. R. 9 E. R. 10 E. R. 11 E.

LAGRANGE COUNTY | STEUBEN COUNTY | ELKHART COUNTY | KOSCIUSKO COUNTY | DE KALB COUNTY | WHITLEY COUNTY | ALLEN COUNTY

1 2 3 4 5 6
7 8 9 10 11 12
13 14 15 16 17 18
19 20 21 22 23 24
25 26 27 28 29 30
31 32 33 34 35 36
37 38 39 40 41 42
43 44 45 46 47 48
49 50 51 52 53

PERRY · ELKHART · ORANGE · WAYNE · WASHINGTON · NOBLE · GREEN · SWAN · SPARTA · YORK · JEFFERSON · ALLEN

Wolcottville · Jones Lake · Tamarack Lake · Elkhart R. · Cree Lake · Steinberger Lake · Rome City · Waldron Lake · Cosperville · Sylvan Lake · Ligonier · Diamond Lake · Wawaka · Brimfield · Kendallville · Little Long Lake · Round Lake · Bixler Lake · Eagle Lake · Lisbon · Cromwell · Kimmell · Albion · Indian Village · Avilla · Kapp Lake · Wolflake · Munee Lake · Forker Cr · Tippecanoe River · Wilmot · Smalley Lake · Bear Lake · Ormas · Swan · Merriam · Big Long Lake · Loon Lake · Blue River · Egypt · Willow Creek · Black Creek · Ari

Penn Central · Baltimore and Ohio · B&O · P C

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter A, B, C, D, or E shows the slope. Most symbols without a slope letter are those for nearly level soils, but some are for miscellaneous land types. A final number 2 or 3 in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
Ad	Adrian muck
Am	Adrian muck, drained
Au	Aubbeenaubbee fine sandy loam
BlA	Blount silt loam, 0 to 2 percent slopes
BlB2	Blount silt loam, 2 to 4 percent slopes, eroded
BoB	Boyer loamy sand, 2 to 6 percent slopes
BoC	Boyer loamy sand, 6 to 12 percent slopes
BoD2	Boyer loamy sand, 12 to 18 percent slopes, eroded
Br	Brady sandy loam
Bx	Brookston silt loam
CcC3	Casco sandy clay loam, 8 to 15 percent slopes, severely eroded
ChB	Chelsea fine sand, 2 to 6 percent slopes
ChC	Chelsea fine sand, 6 to 12 percent slopes
CrA	Crosier loam, 0 to 2 percent slopes
Ed	Edwards muck
Em	Edwards muck, drained
FoA	Fox sandy loam, 0 to 2 percent slopes
FoB	Fox sandy loam, 2 to 6 percent slopes
FoC2	Fox sandy loam, 6 to 12 percent slopes, eroded
FsD2	Fox-Casco sandy loams, 12 to 18 percent slopes, eroded
FsE2	Fox-Casco sandy loams, 18 to 25 percent slopes, eroded
Fu	Fulton silt loam
Gf	Gilford sandy loam
HaA	Haskins loam, 0 to 2 percent slopes
Hh	Homer loam
Hm	Houghton muck
Ho	Houghton muck, drained
La	Lake borders
Ma	Marl beds
Mb	Marsh
MdB	Martinsville fine sandy loam, 2 to 6 percent slopes
MeB	Metea loamy fine sand, 2 to 6 percent slopes
MfB2	Miami loam, 2 to 6 percent slopes, eroded
MfC2	Miami loam, 6 to 12 percent slopes, eroded
MfD2	Miami loam, 12 to 18 percent slopes, eroded
MfE2	Miami loam, 18 to 25 percent slopes, eroded
MgC3	Miami clay loam, 6 to 12 percent slopes, severely eroded
MgD3	Miami clay loam, 12 to 18 percent slopes, severely eroded
MhA	Miami loam, gravelly substratum, 0 to 2 percent slopes
MhB2	Miami loam, gravelly substratum, 2 to 6 percent slopes, eroded
Mn	Milford silty clay loam
MrB2	Morley silt loam, 2 to 6 percent slopes, eroded
MrC2	Morley silt loam, 6 to 12 percent slopes, eroded
MrD2	Morley silt loam, 12 to 18 percent slopes, eroded
MsC3	Morley silty clay loam, 6 to 12 percent slopes, severely eroded
MsD3	Morley silty clay loam, 12 to 18 percent slopes, severely eroded
MtE	Morley soils, 18 to 25 percent slopes
MuC2	Morley, Miami, and Rawson loams, 6 to 12 percent slopes, eroded
OsB	Oshtemo loamy sand, 2 to 6 percent slopes
OsC	Oshtemo loamy sand, 6 to 12 percent slopes
OtA	Oshtemo sandy loam, 0 to 2 percent slopes
Pb	Palms muck, drained
PdA	Parr loam, 0 to 2 percent slopes
Pe	Pewamo silty clay loam
RaB	Rawson sandy loam, 2 to 6 percent slopes
RaC2	Rawson sandy loam, 6 to 12 percent slopes, eroded
RbA	Rawson loam, 0 to 2 percent slopes
RcB	Rawson loam, 2 to 6 percent slopes
RdB2	Rawson, Morley, and Miami loams, 2 to 6 percent slopes, eroded
Re	Rensselaer loam
RsA	Riddles sandy loam, 0 to 2 percent slopes
RsB	Riddles sandy loam, 2 to 6 percent slopes
RsC2	Riddles sandy loam, 6 to 12 percent slopes, eroded
RsD2	Riddles sandy loam, 12 to 18 percent slopes, eroded
Se	Sebewa loam
Sh	Shoals silt loam
To	Toledo silty clay loam
Wa	Wallkill silt loam
WrA	Warsaw loam, 0 to 2 percent slopes
Ws	Washtenaw silt loam
Wt	Whitaker loam

NOBLE COUNTY, INDIANA

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)

- Located object (label)

- Tank (label)

- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)

  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial

- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

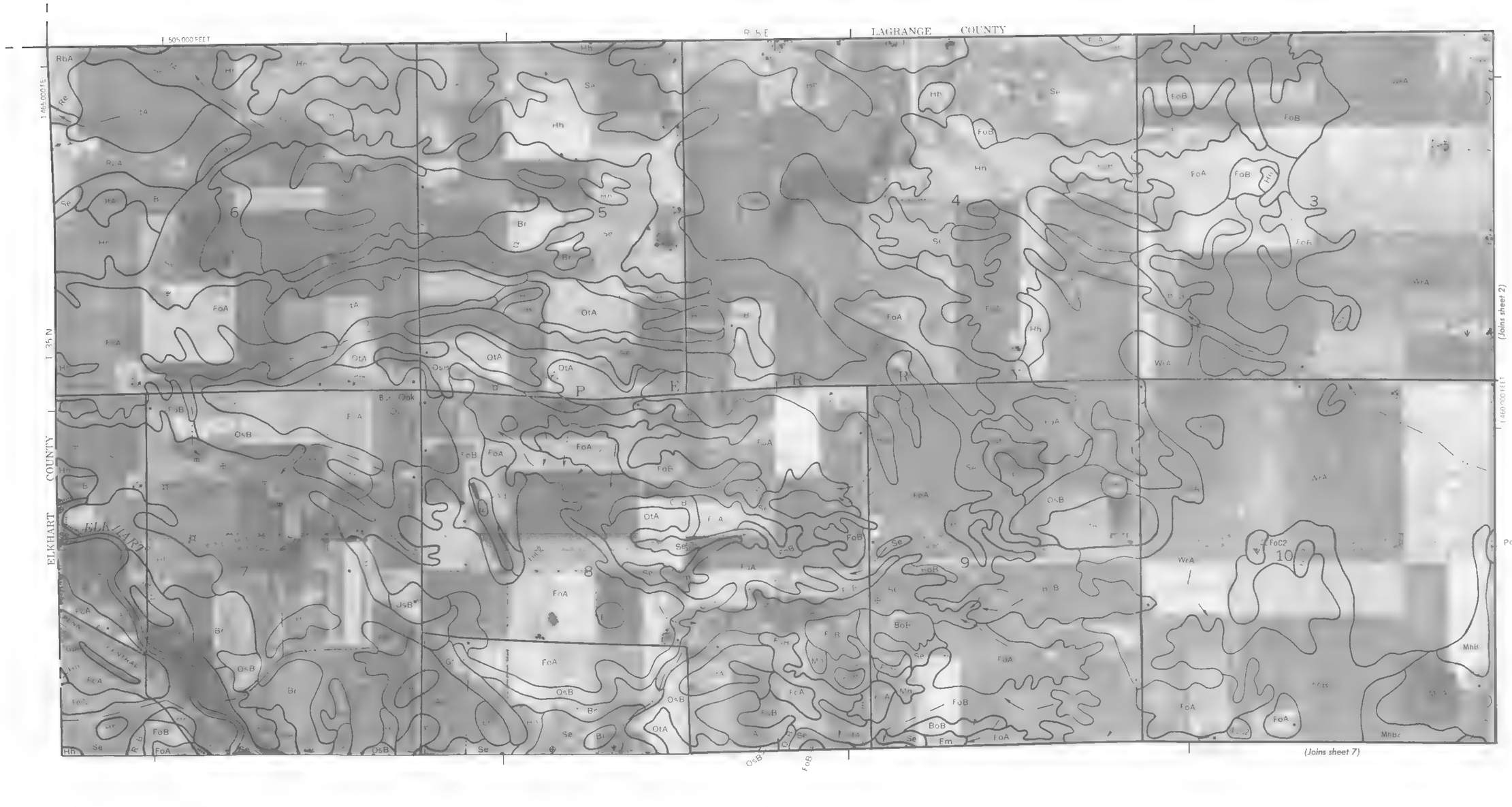
GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Areas of iron accumulation
- High organic surface layer
- Borrow areas
- Calcareous soil



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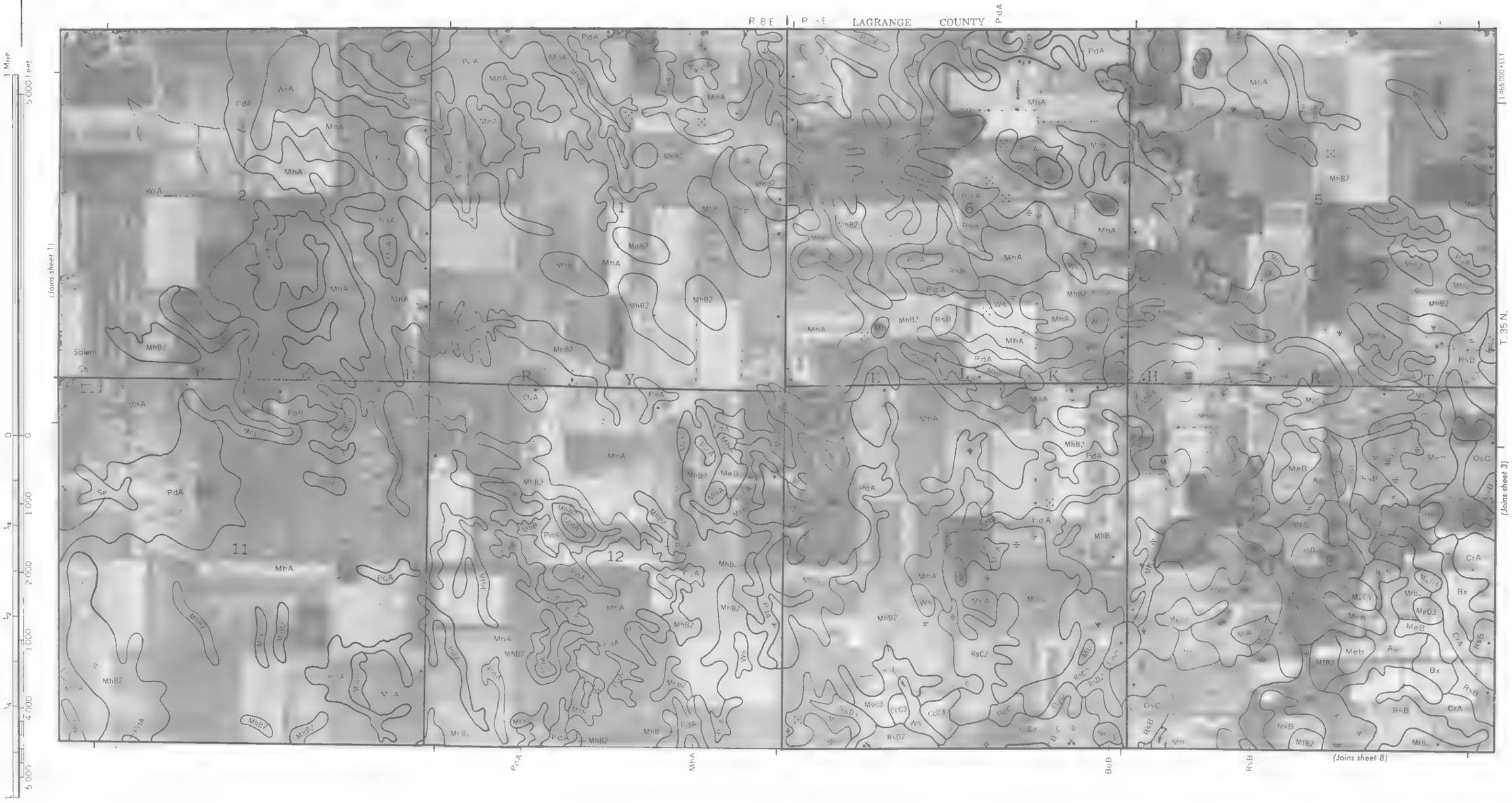

NOBLE COUNTY, INDIANA NO. 2

NOBLE COUNTY, INDIANA NO. 3

3

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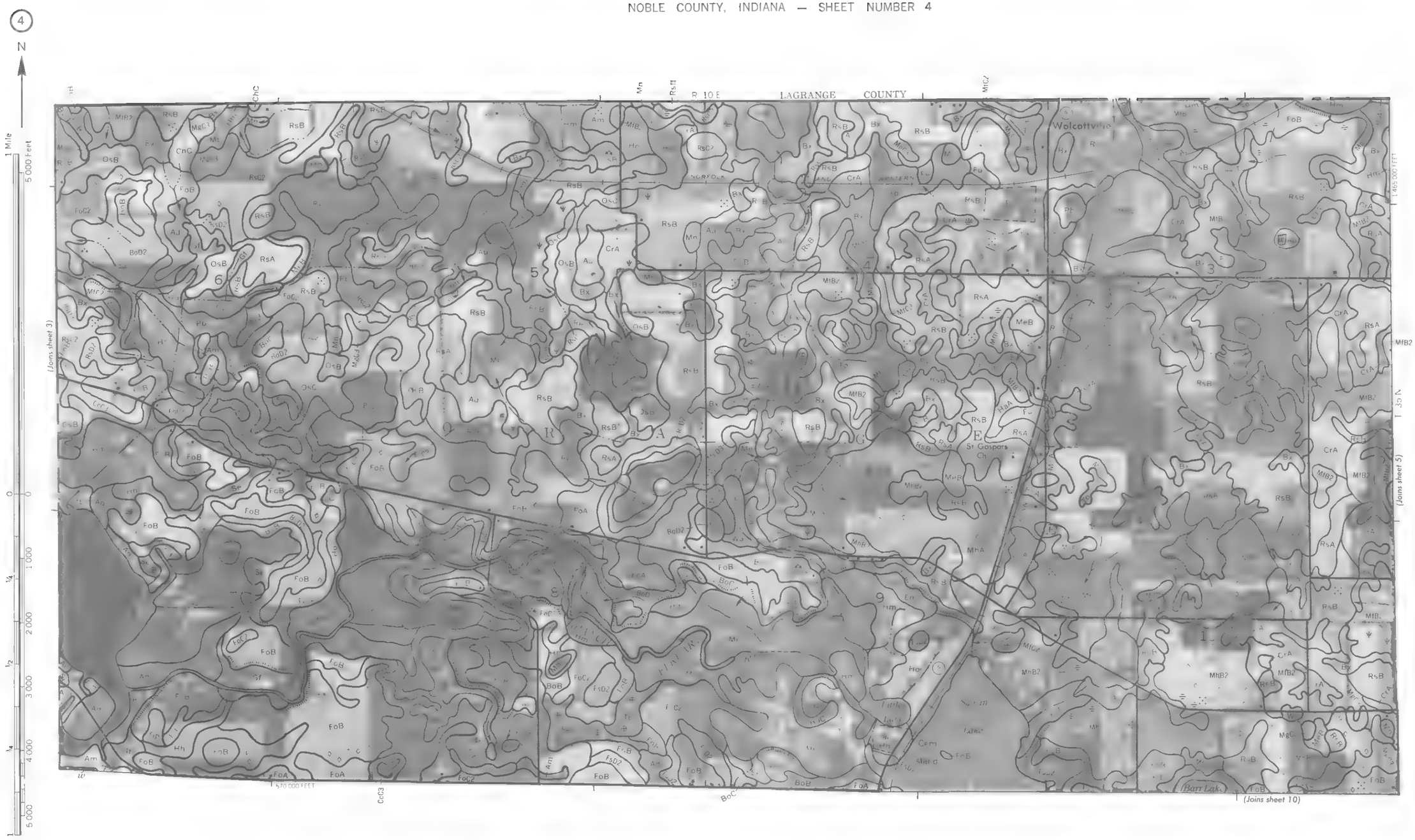

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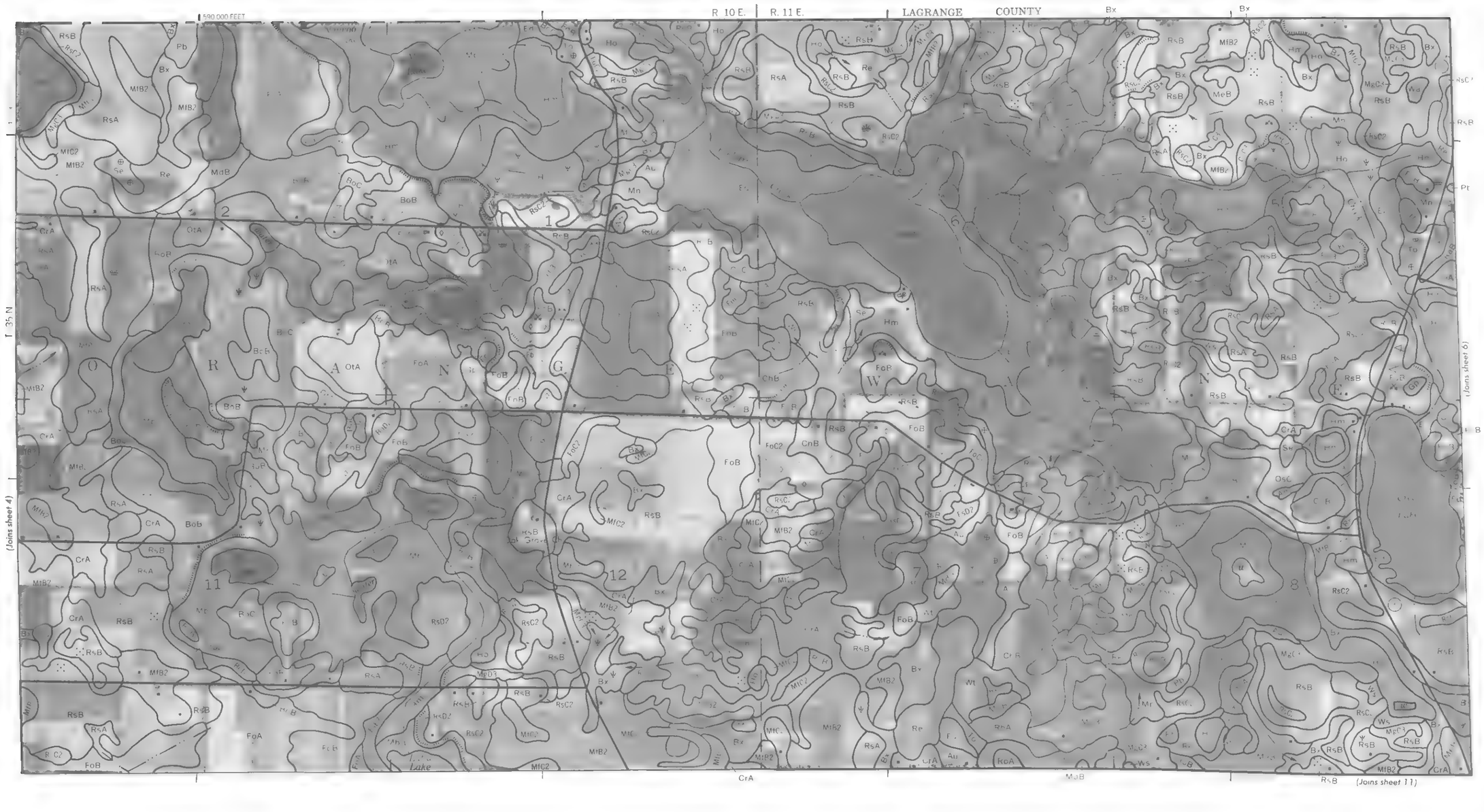
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R. 11 E.
LAGRANGE COUNTY
T. 35 N.
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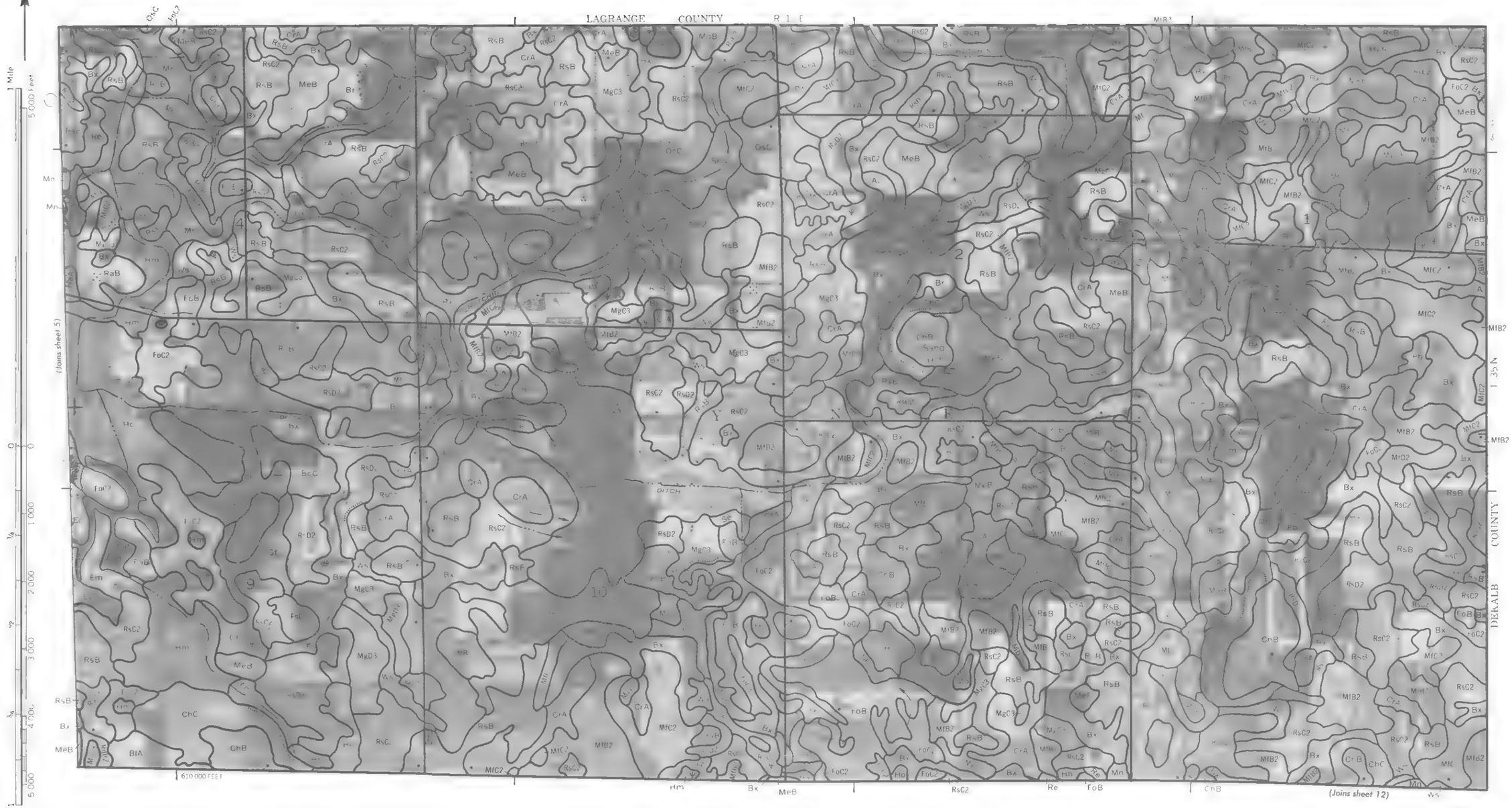
6
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LAGRANGE COUNTY
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DEKALB COUNTY
610 000 FEET
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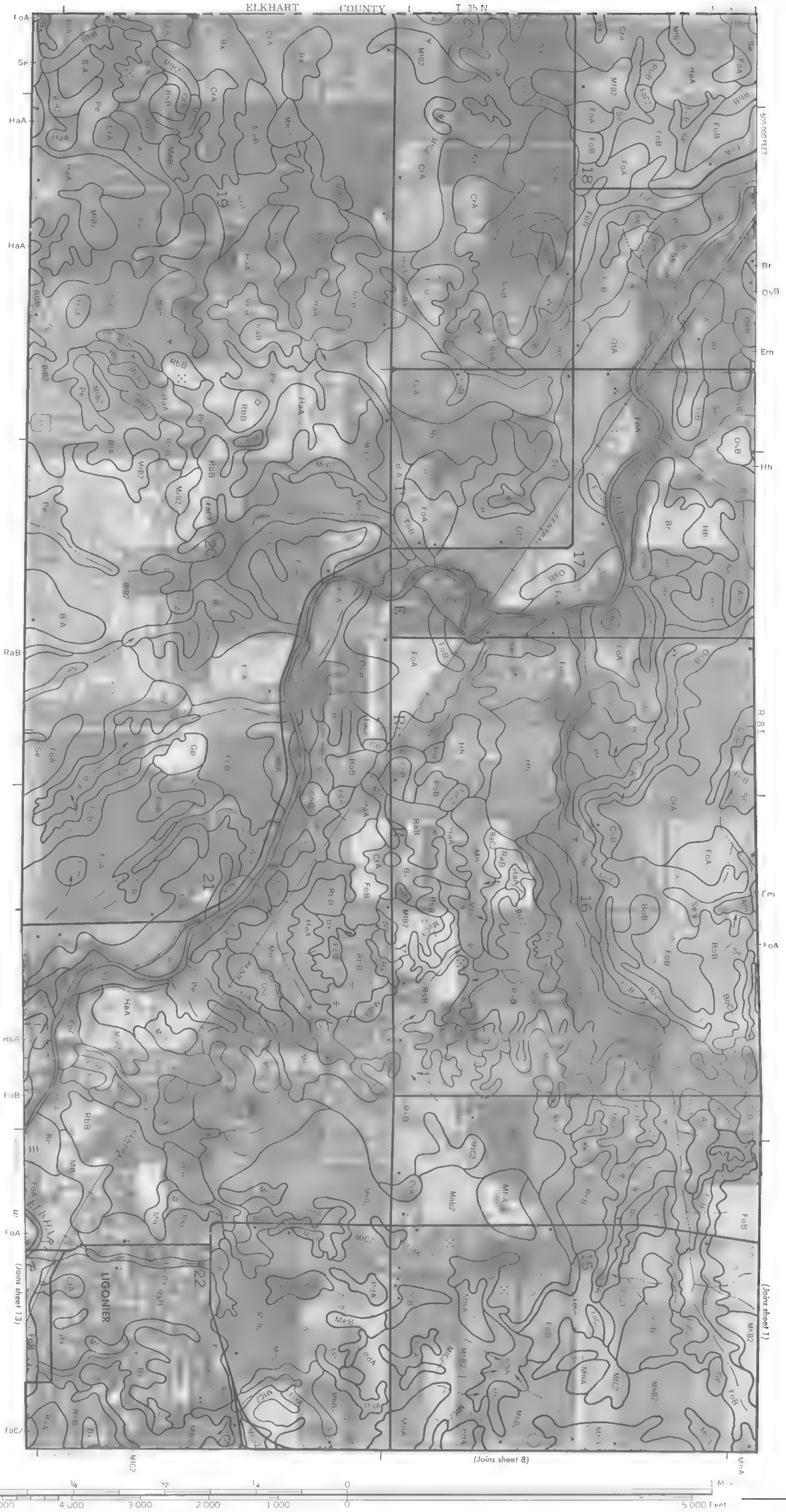
NOBLE COUNTY, INDIANA NO. 6

NOBLE COUNTY, INDIANA NO. 7



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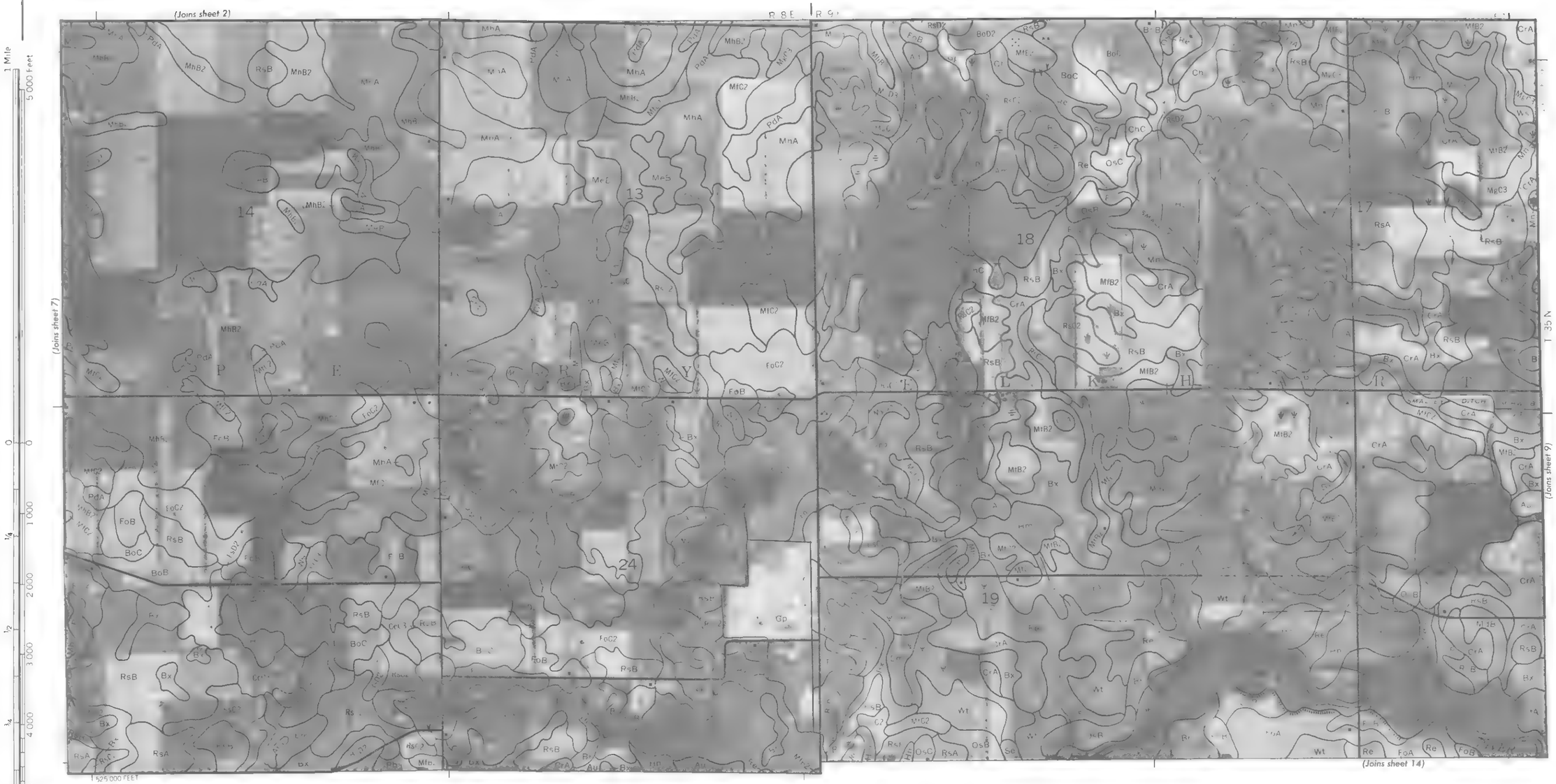

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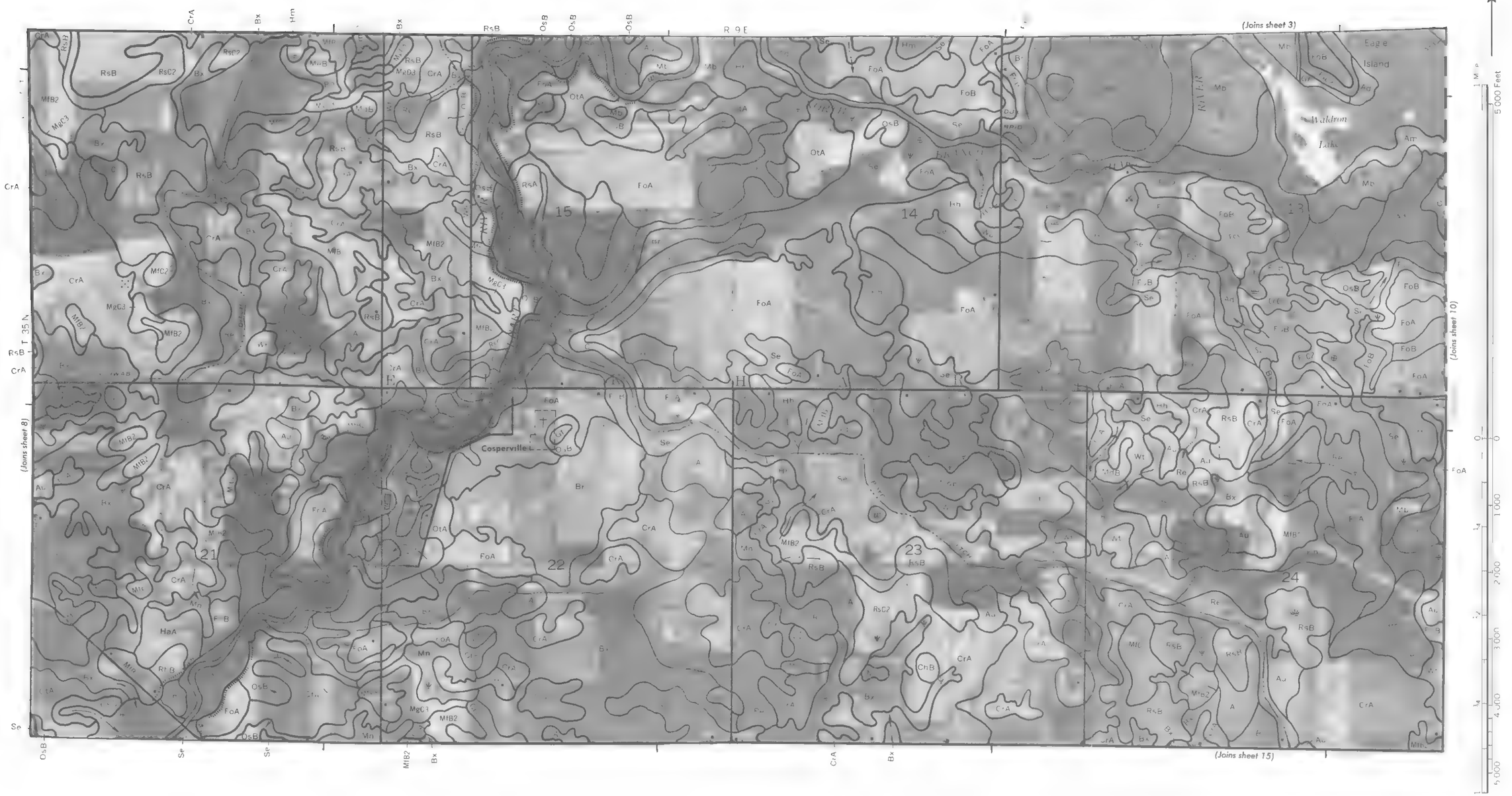

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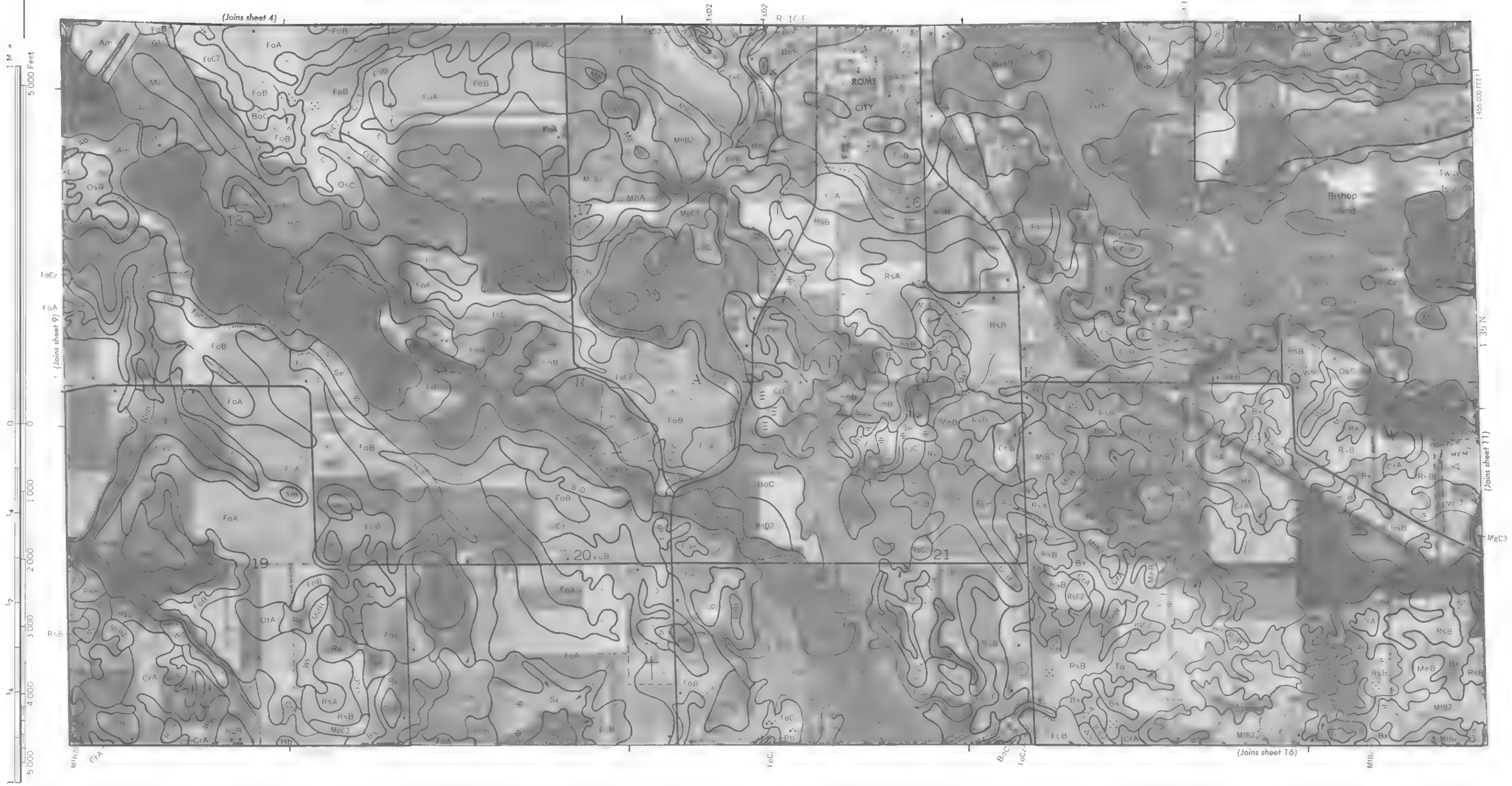

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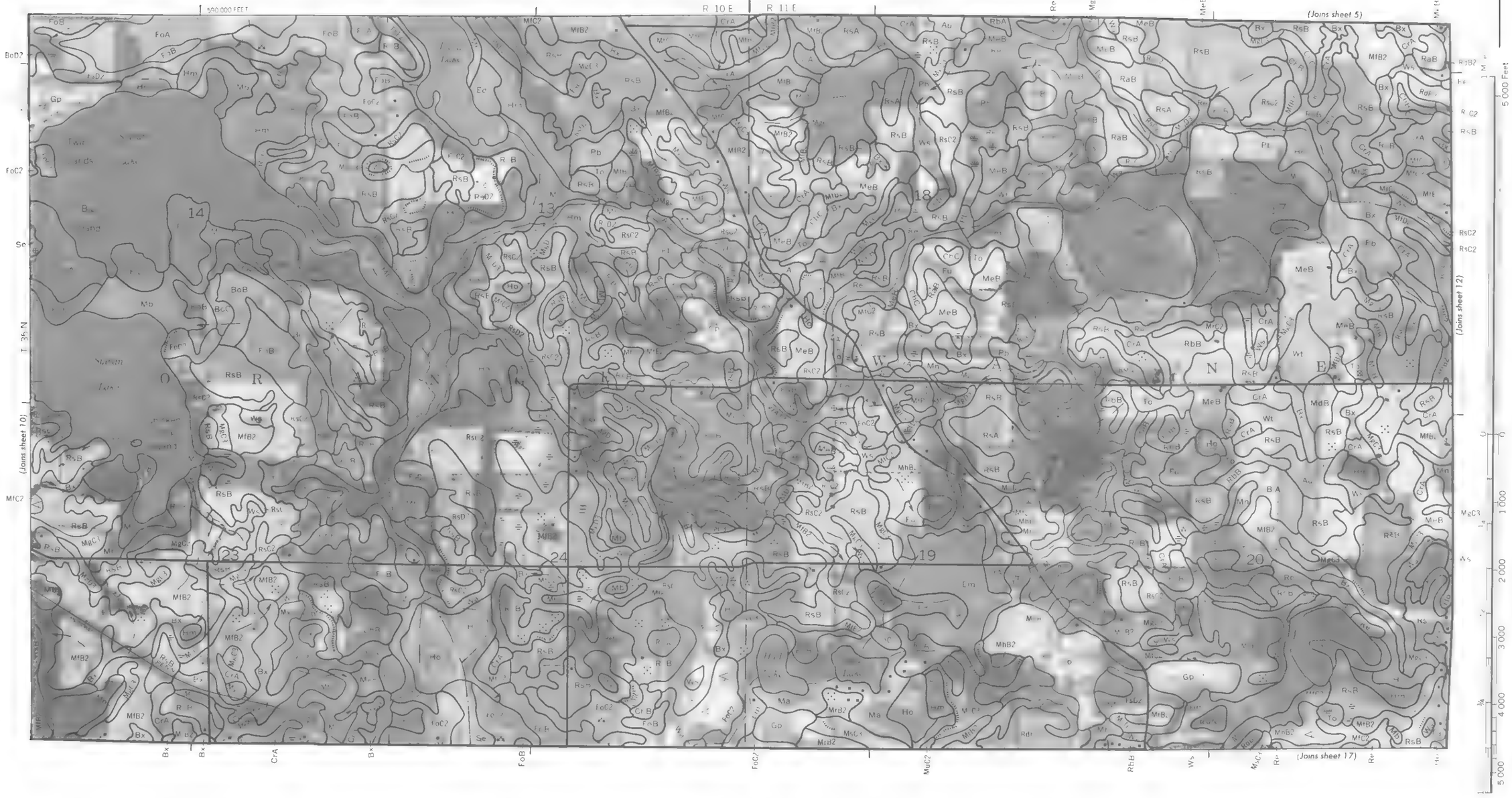

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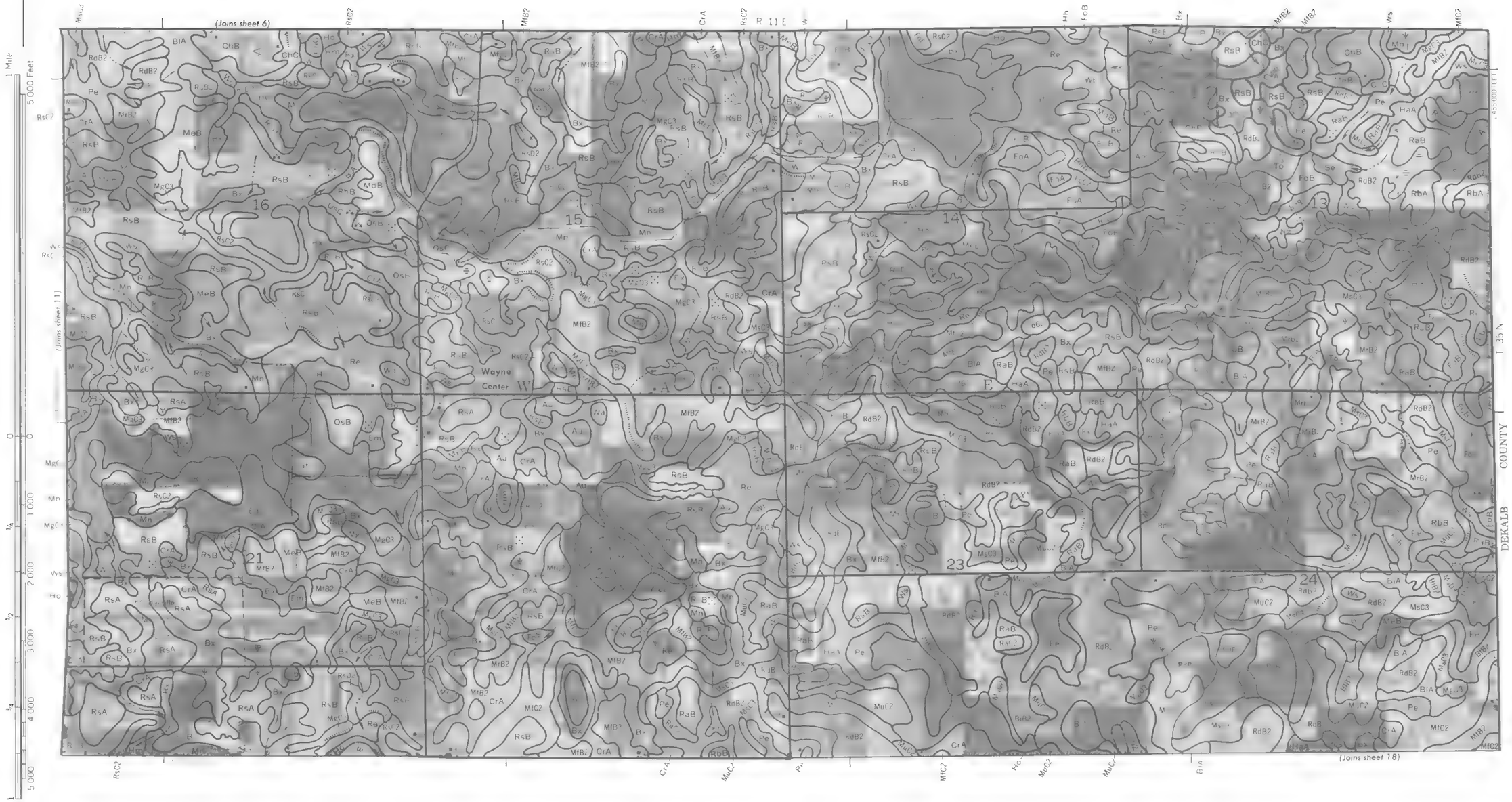

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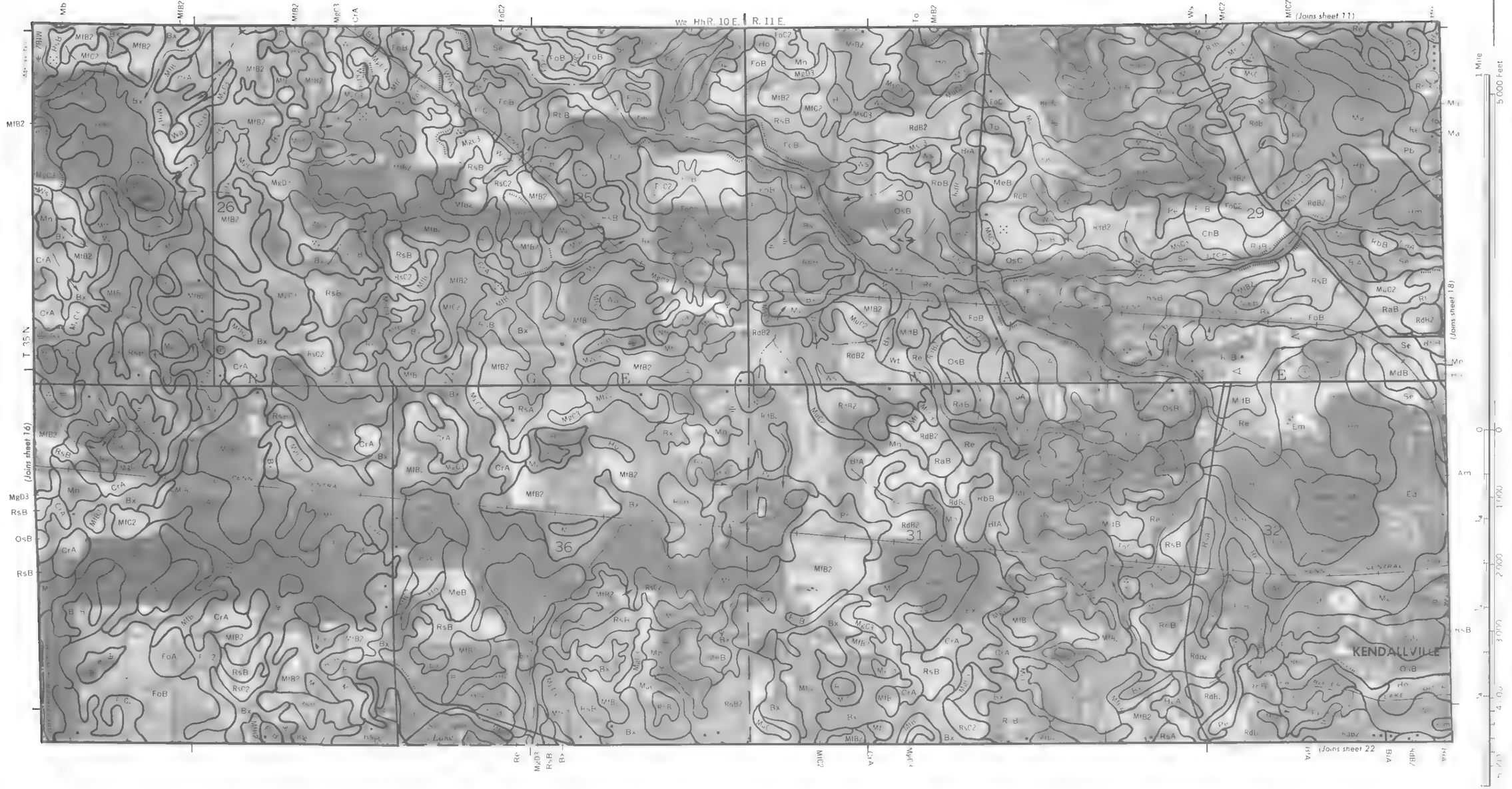

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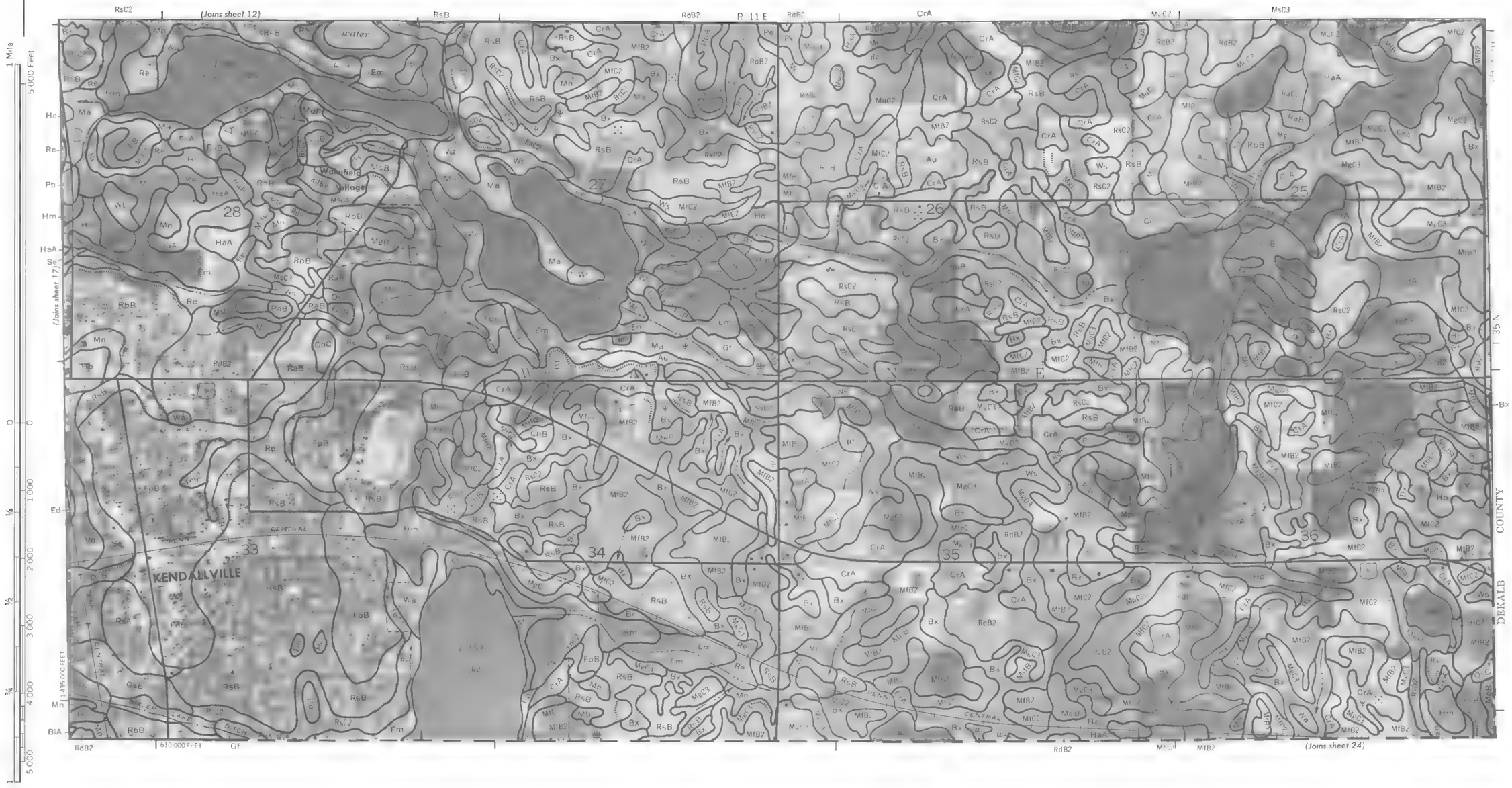
18
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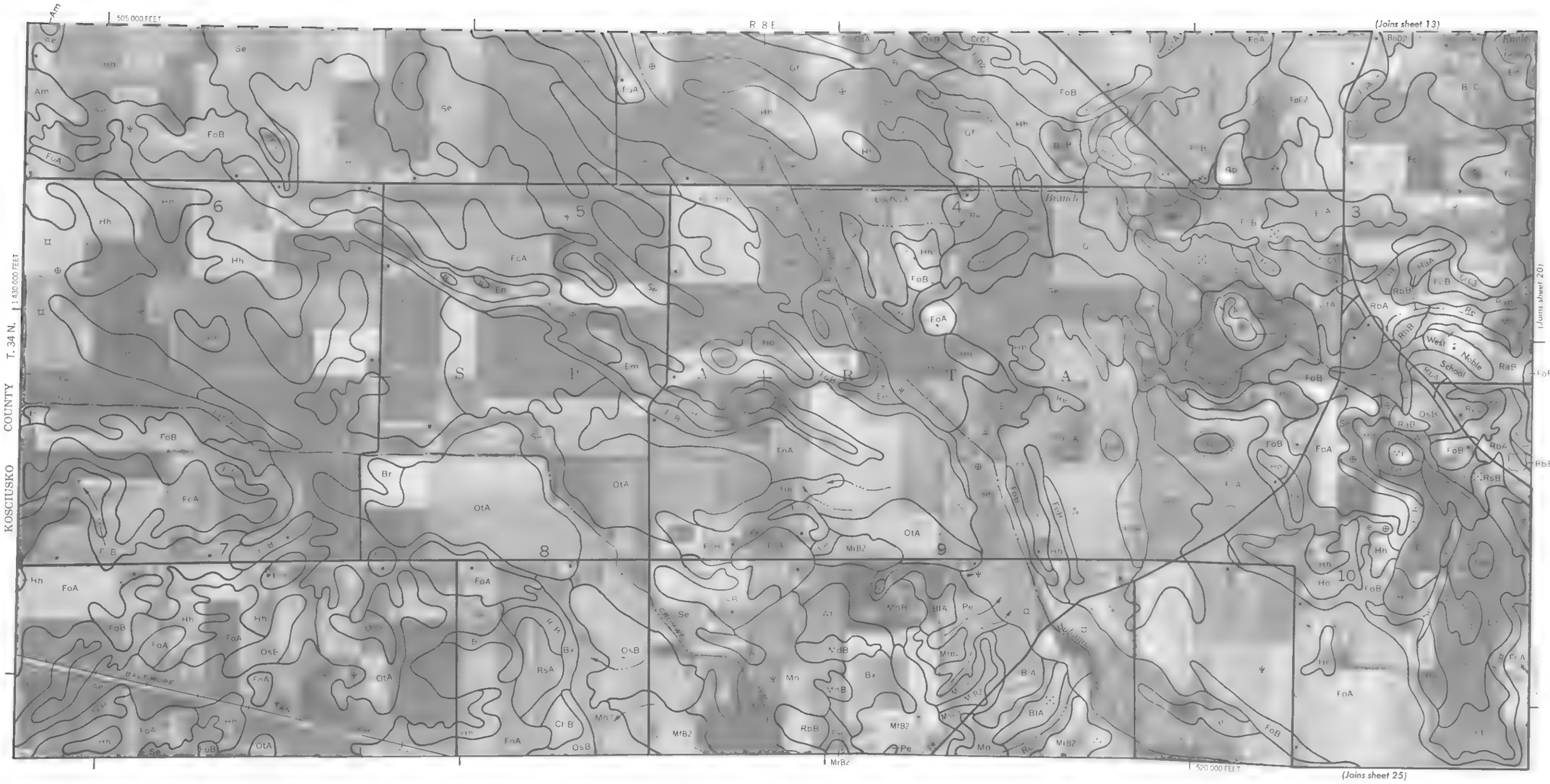
R 11 E
35 N
KENDALLVILLE
Wakefield Village
CENTRAL
COUNTY
DEKALB
NOBLE COUNTY, INDIANA NO. 18



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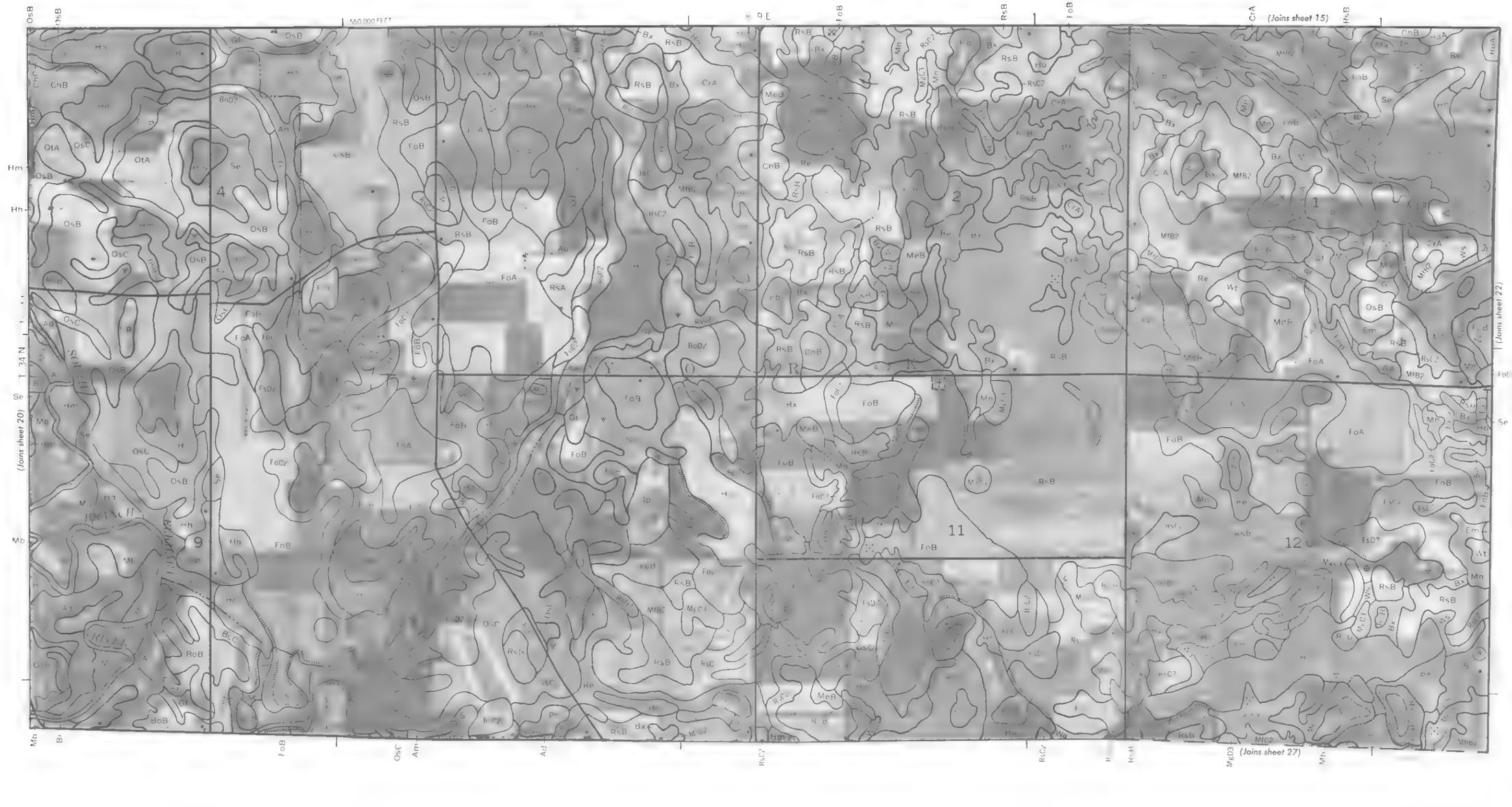

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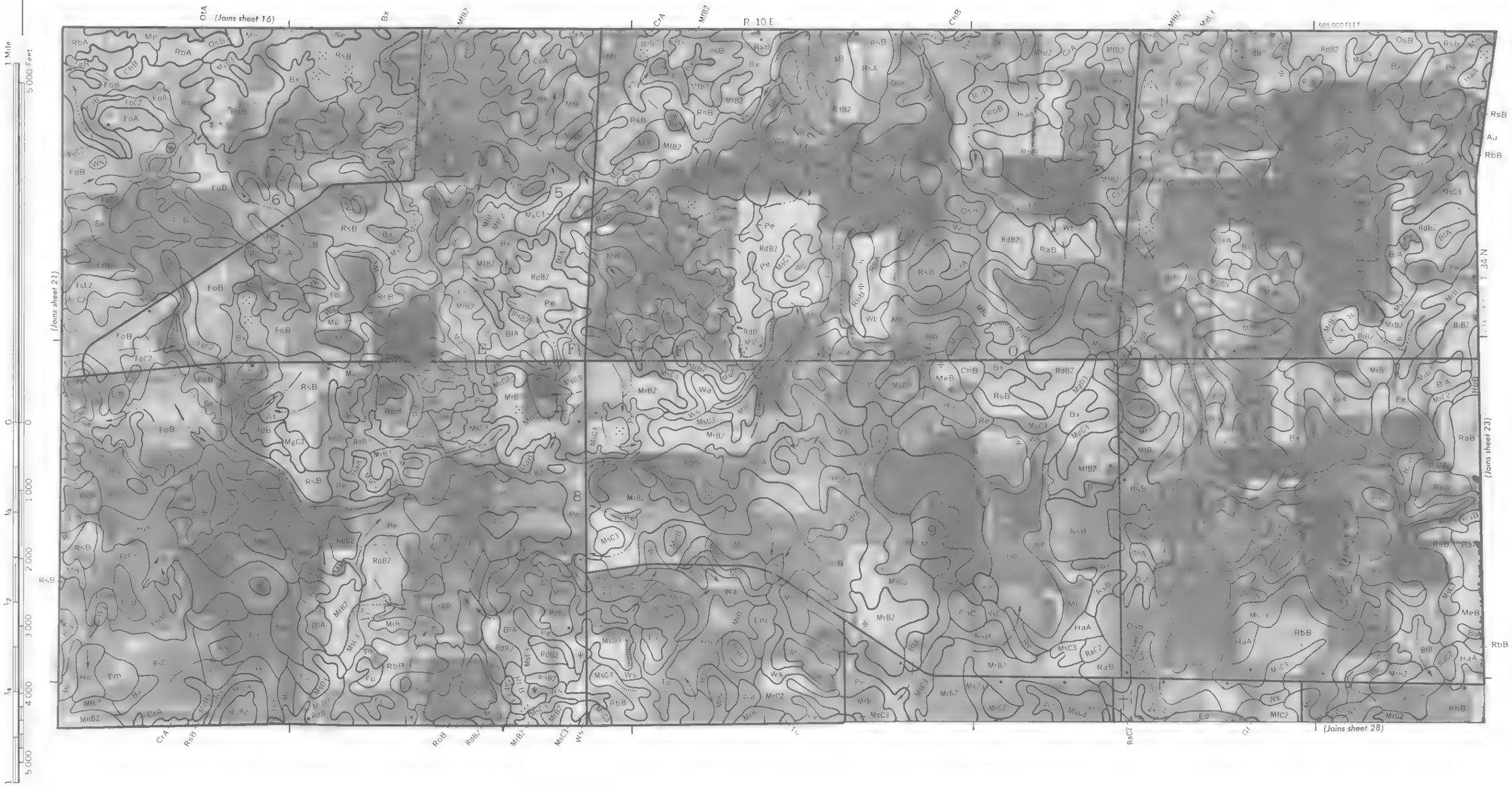

NOBLE COUNTY, INDIANA NO. 22


R 11 E
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(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 29)
NOBLE COUNTY, INDIANA NO. 23
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(Joins sheet 23)
(Joins sheet 30)
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KENDALLVILLE
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Lisbon
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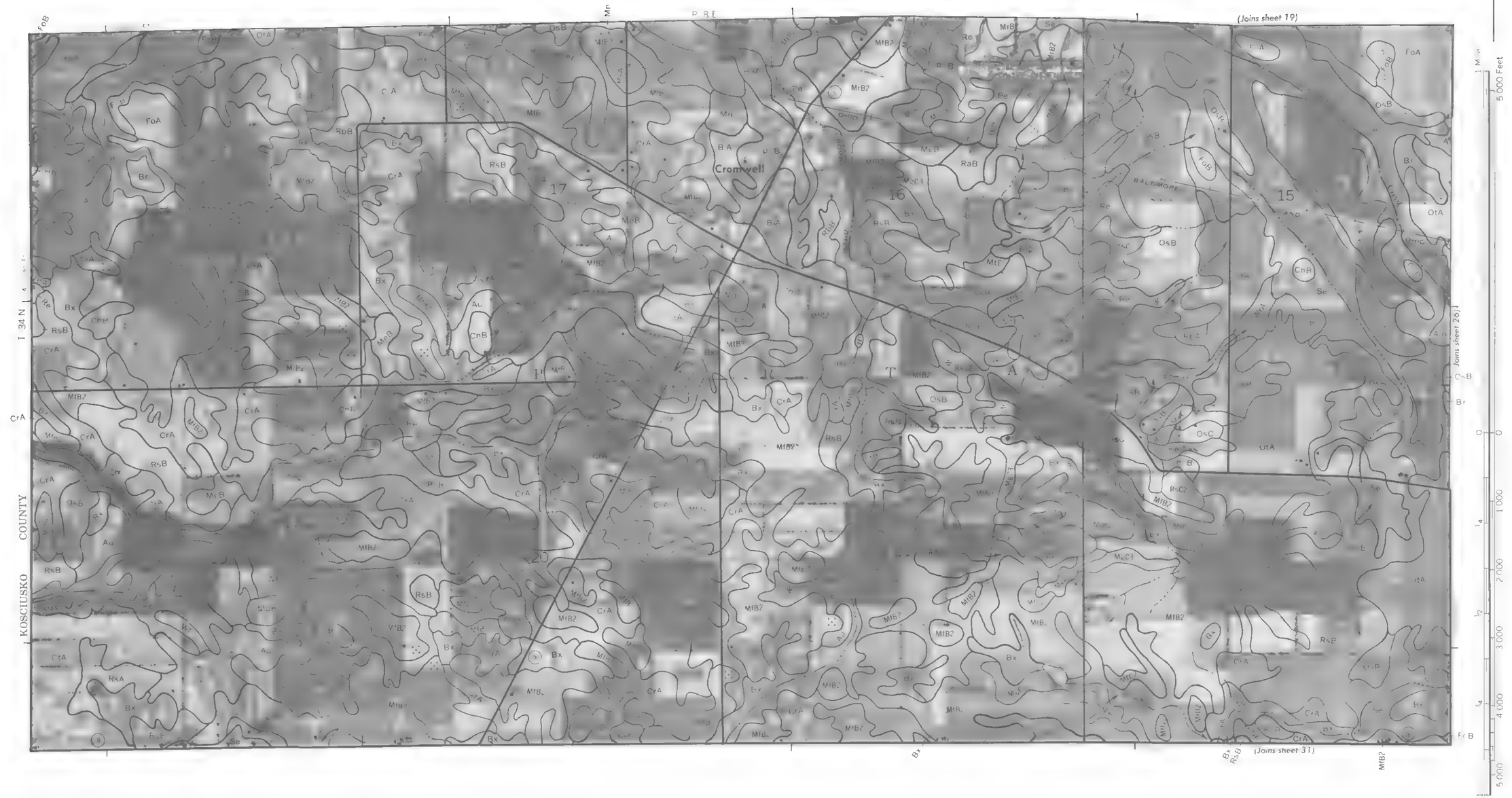

NOBLE COUNTY, INDIANA — NO. 25

NOBLE COUNTY, INDIANA NO. 26

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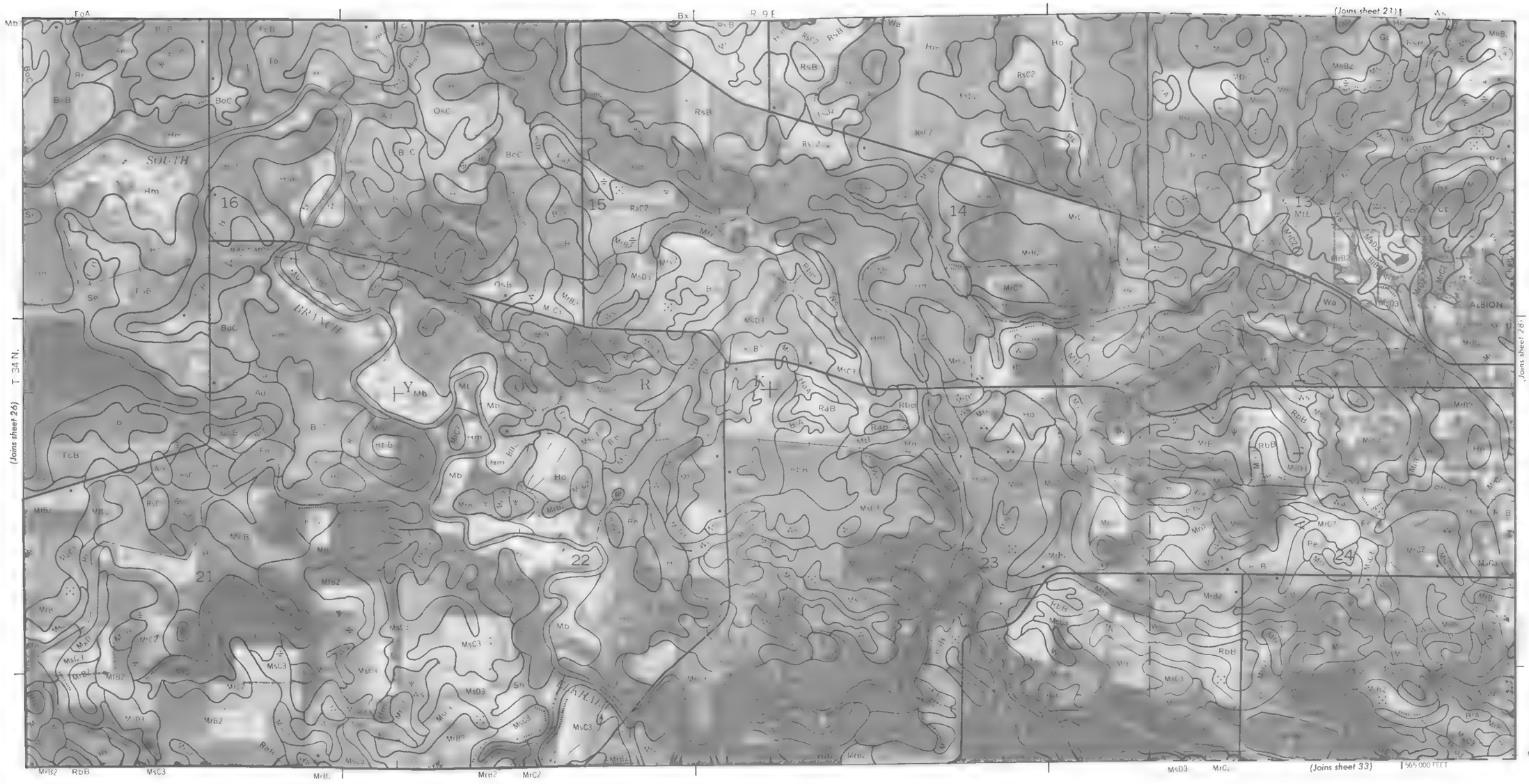

NOBLE COUNTY, INDIANA NO. 27

5,000 Feet
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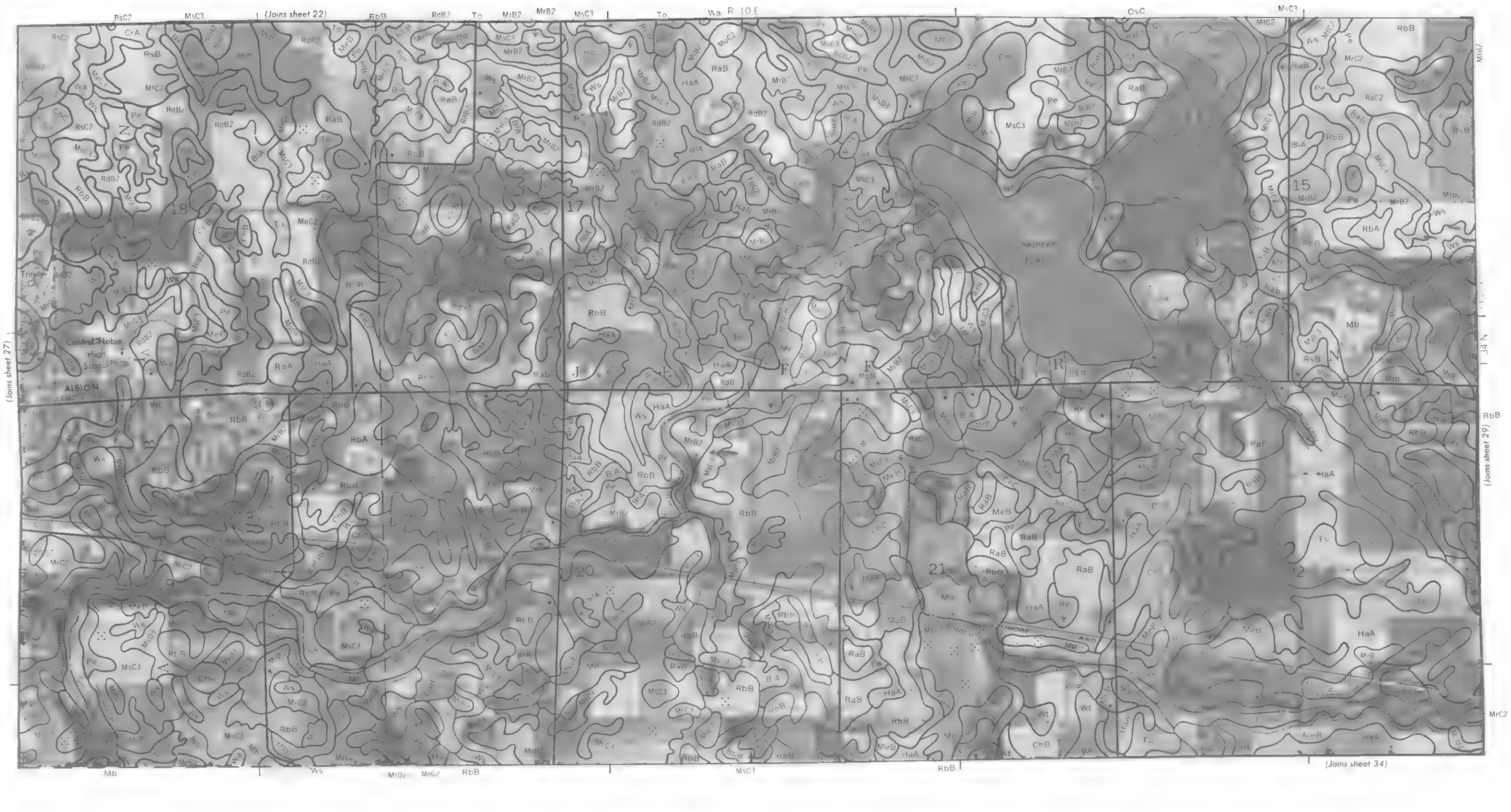

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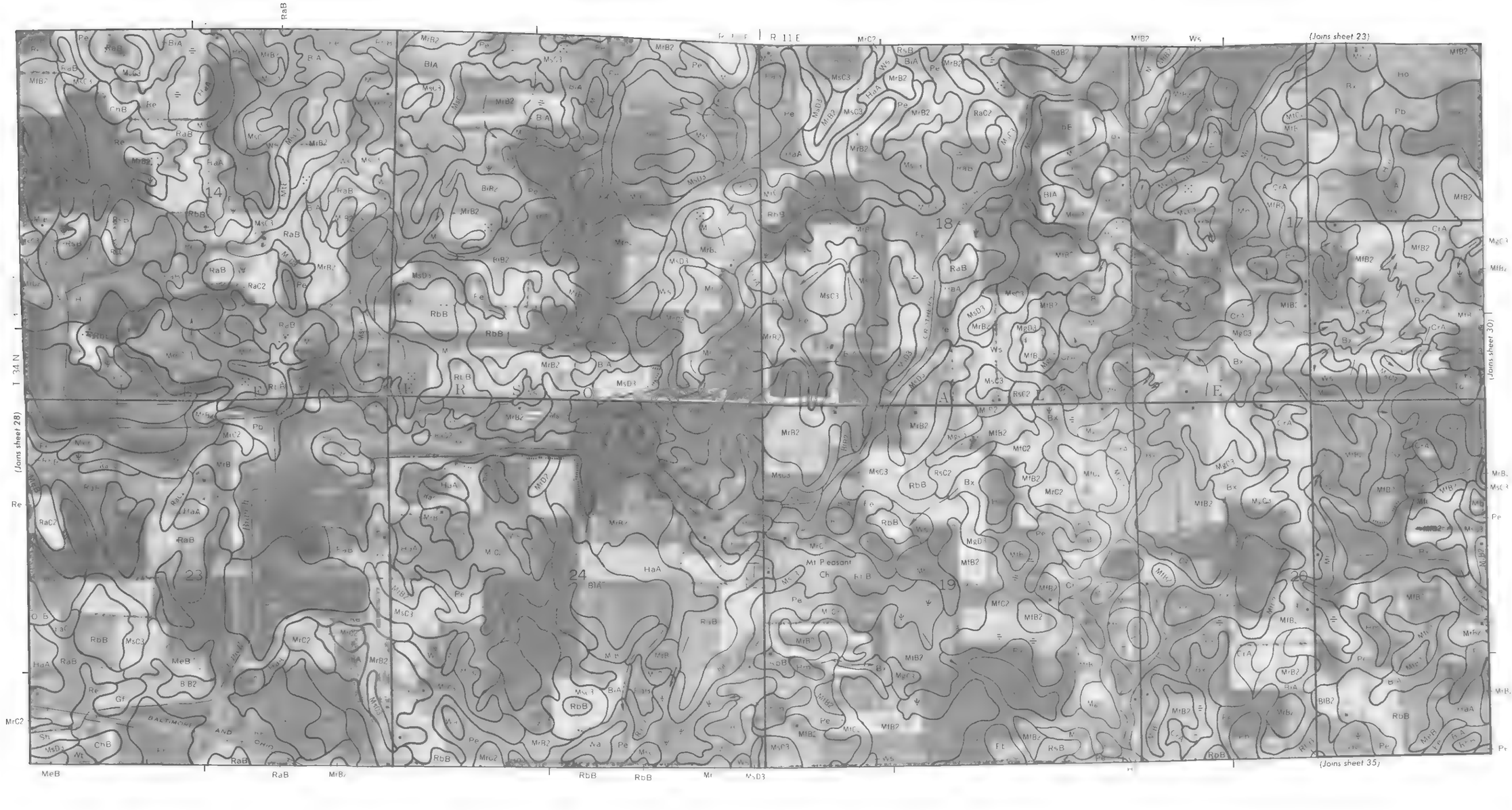
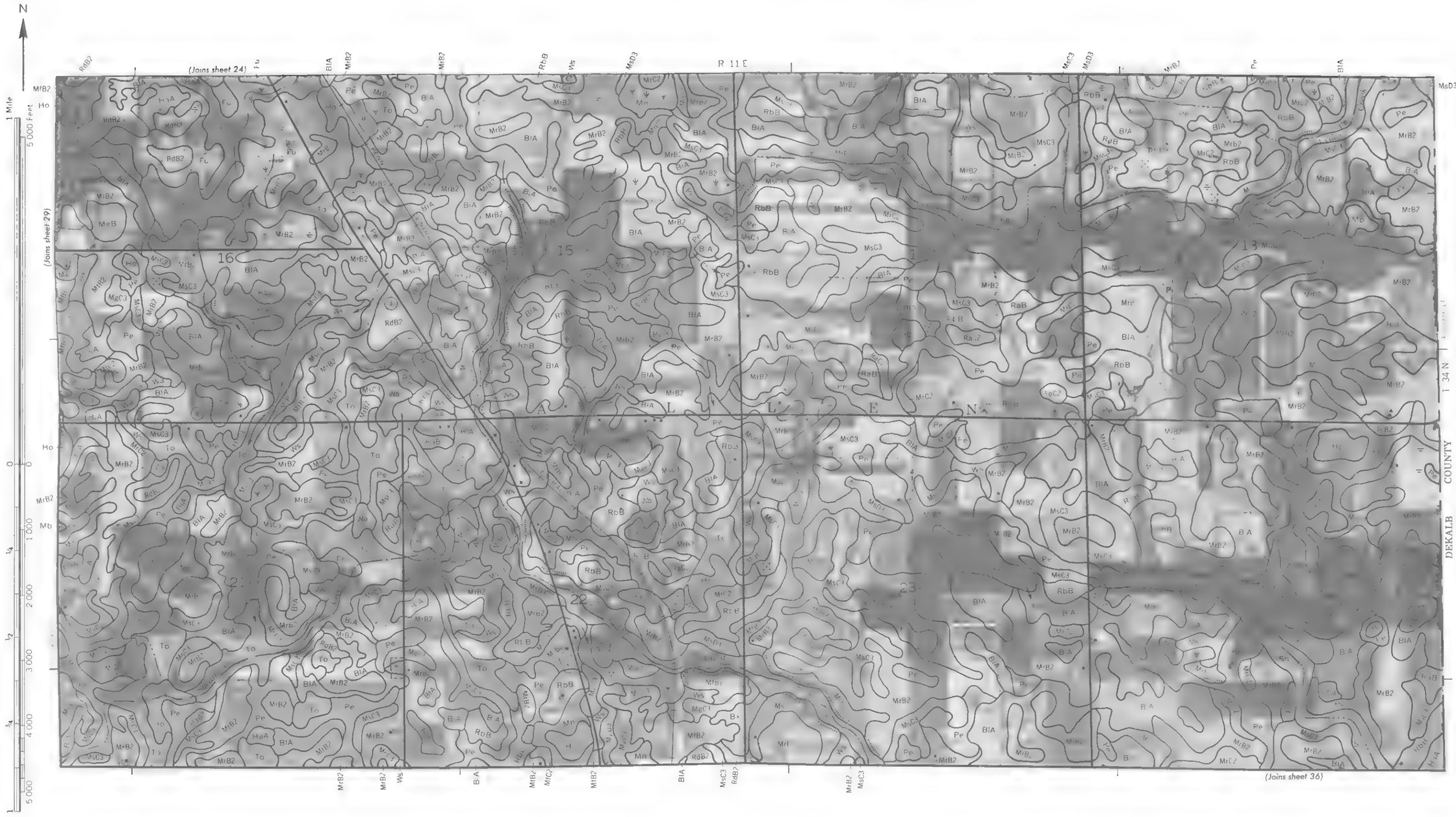
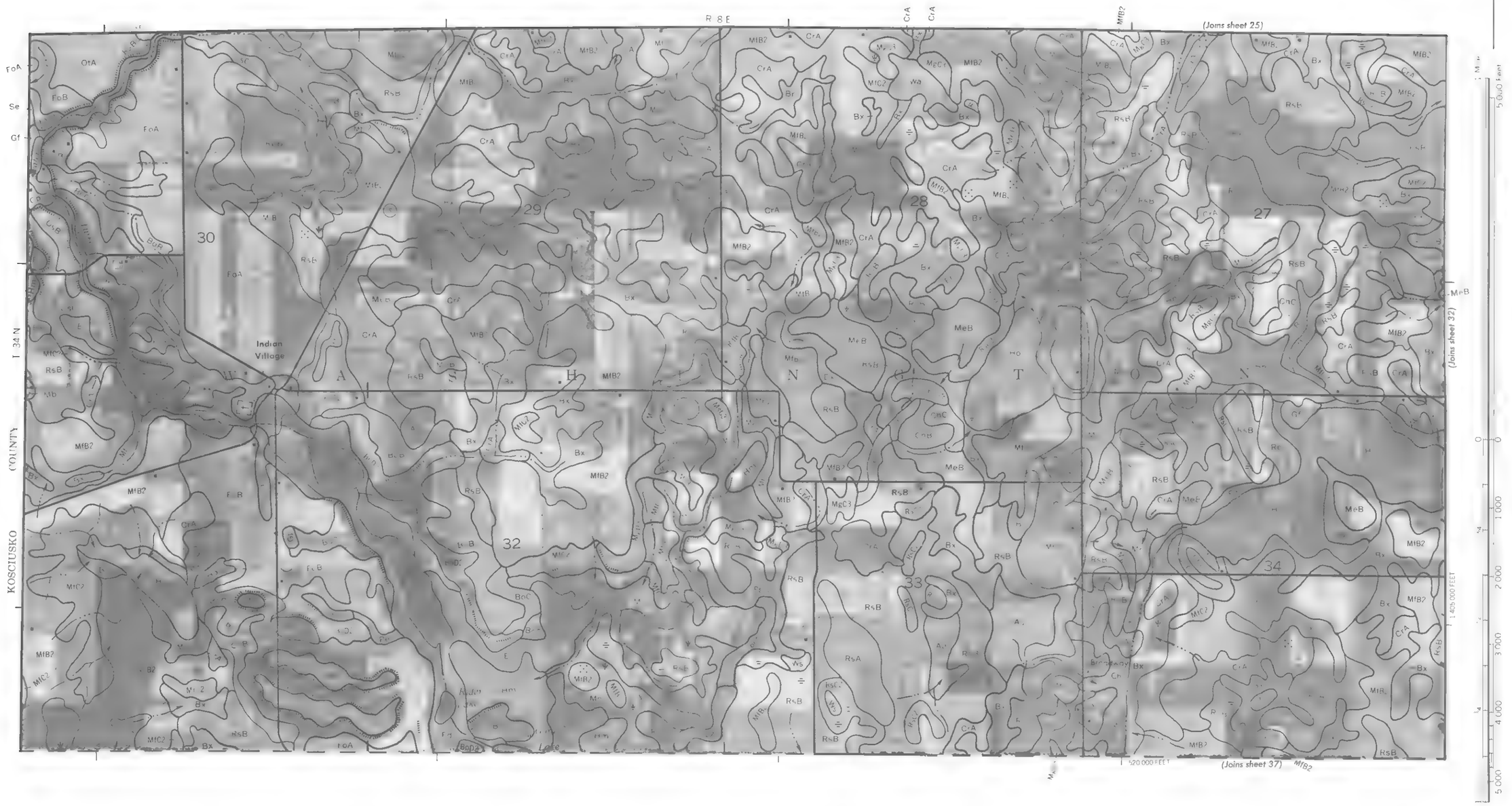
N

NOBLE COUNTY, INDIANA NO. 29

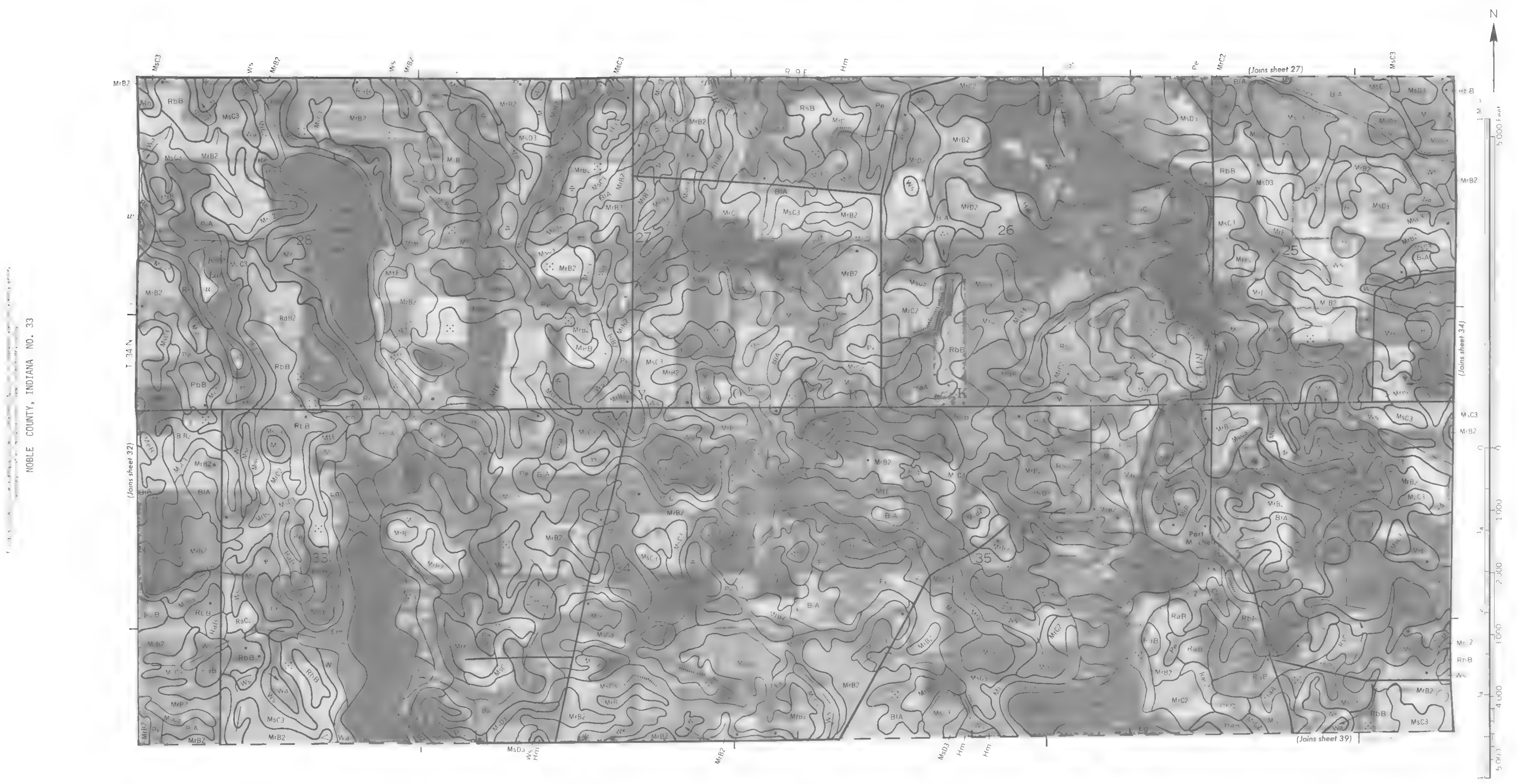


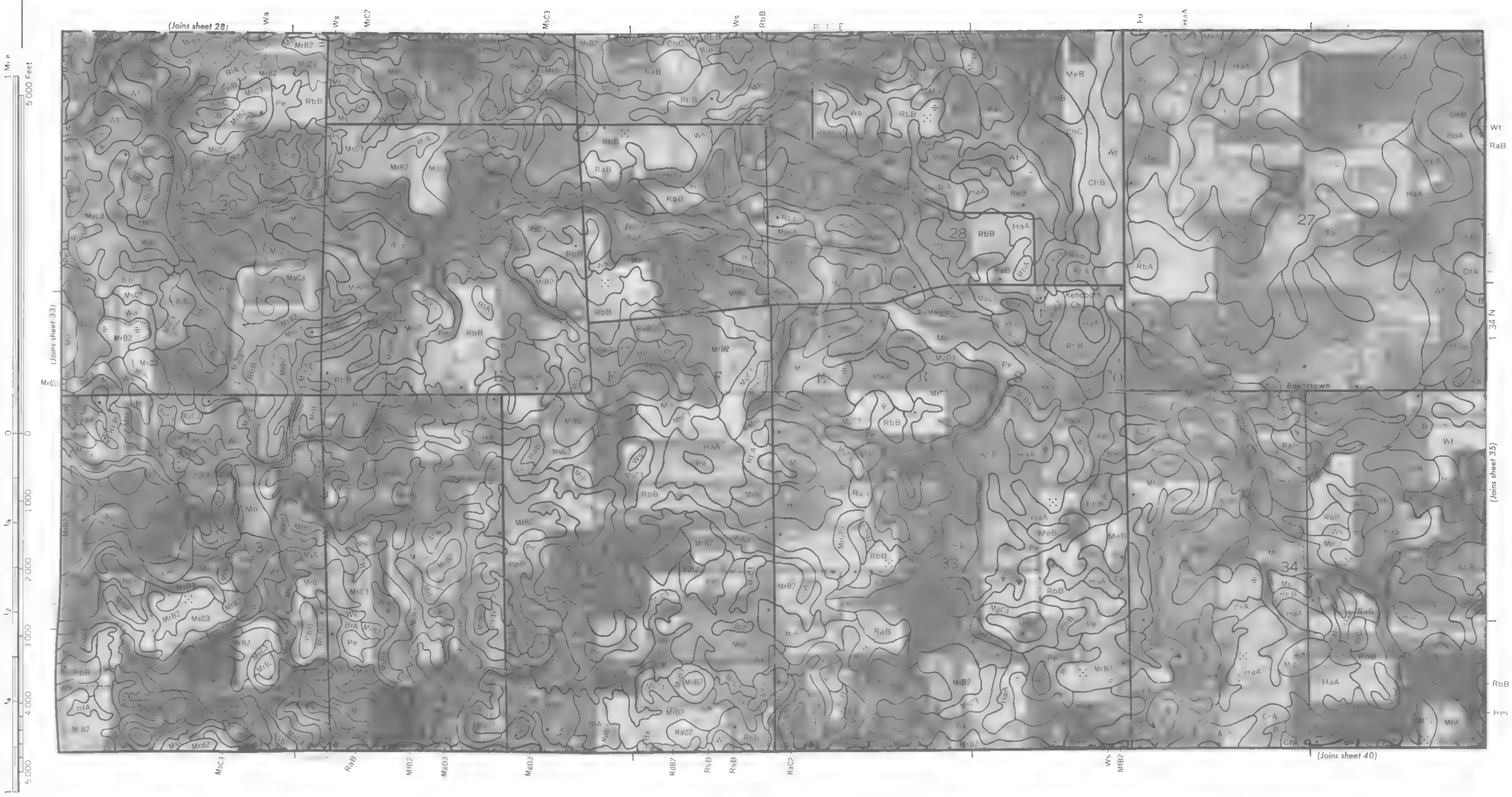

30
N
1 Mile
5 000 Feet
(Joins sheet 24)
(Joins sheet 29)
(Joins sheet 36)
R 11 E
T 34 N
DEKALB COUNTY
NOBLE COUNTY, INDIANA NO. 30



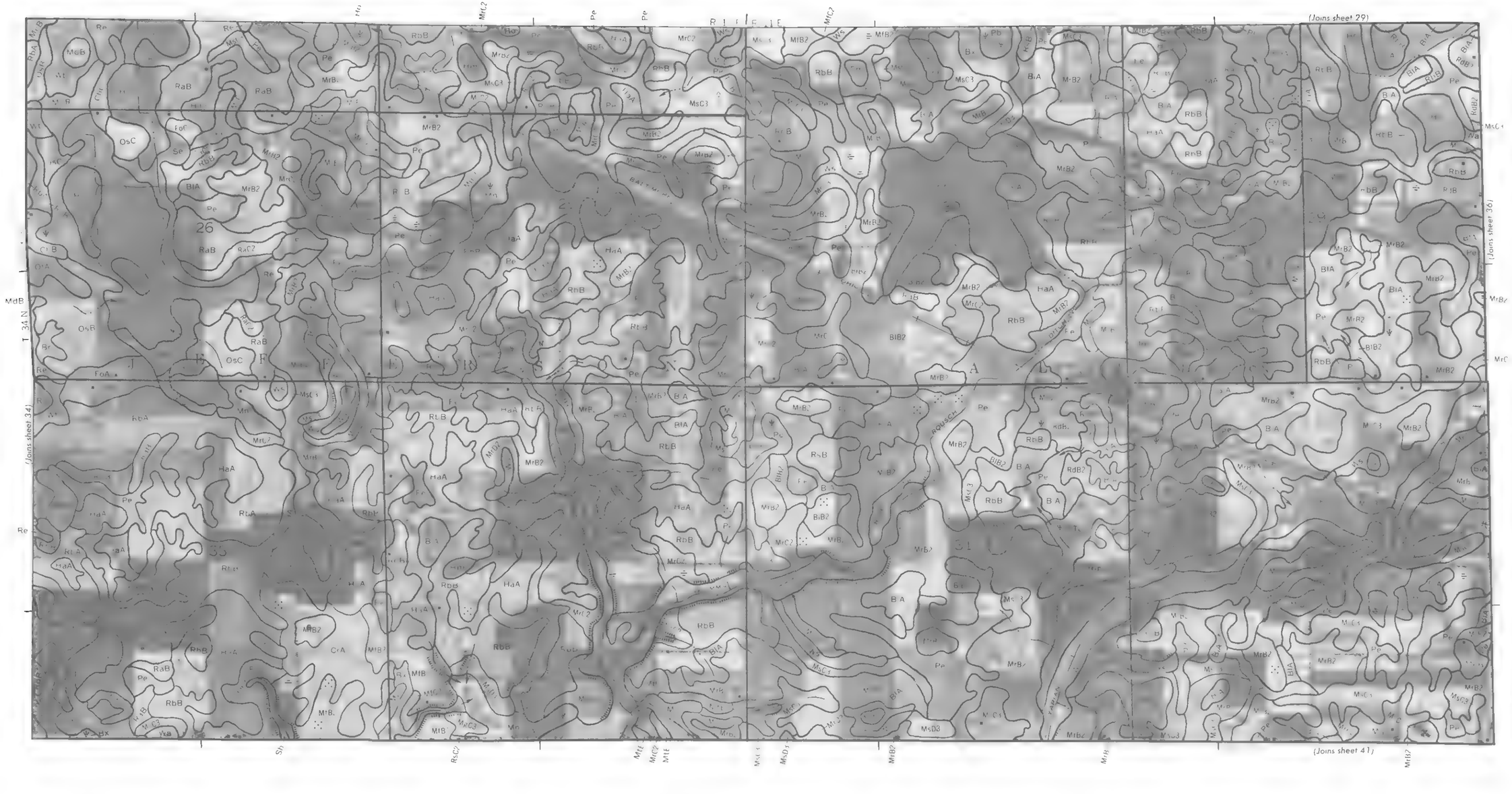
NOBLE COUNTY, INDIANA NO. 31

NOBLE COUNTY, INDIANA NO. 32

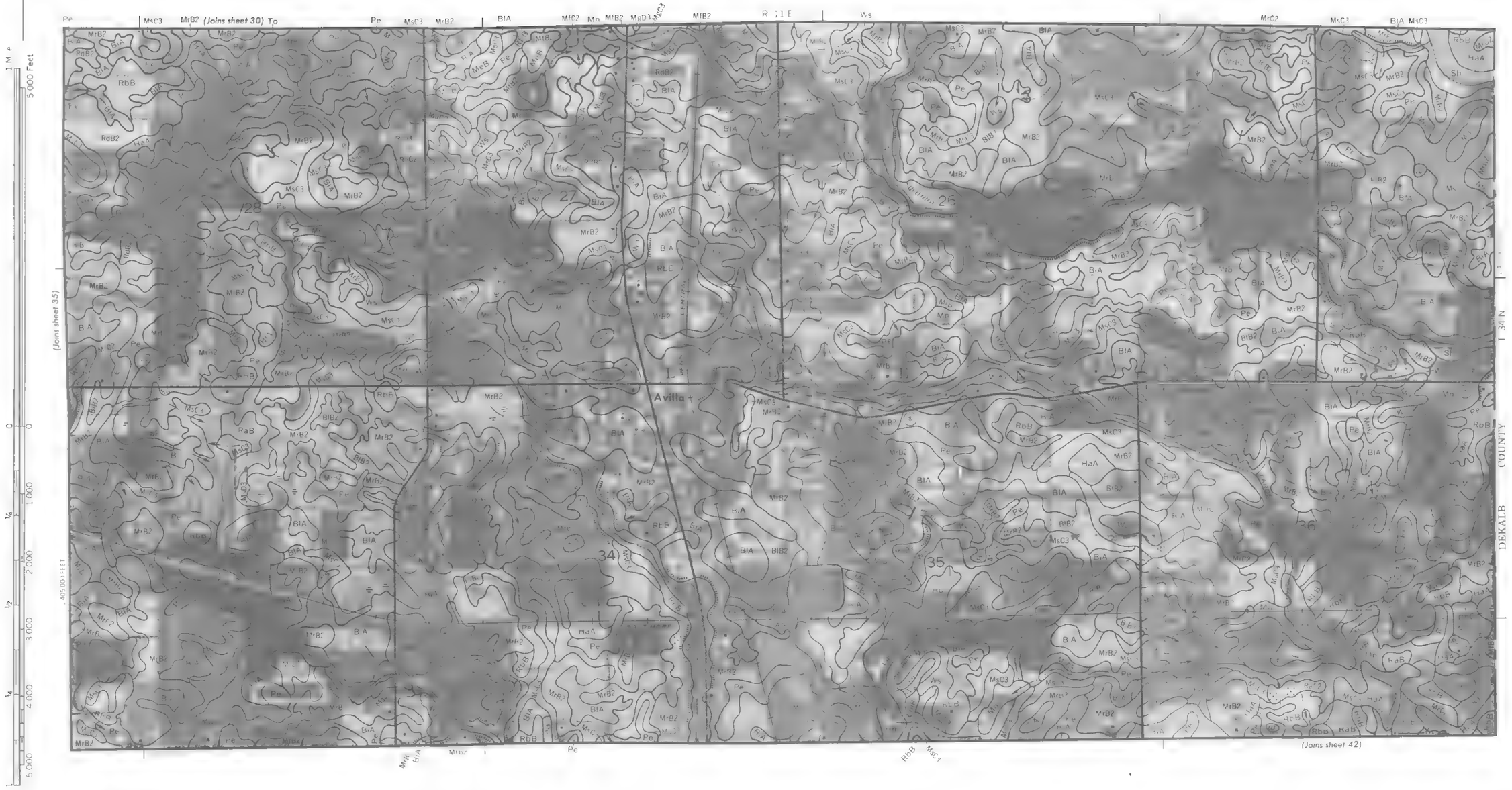

33
N
(Joins sheet 27)
(Joins sheet 34)
(Joins sheet 39)
(Joins sheet 32)
R 9 E
T 34 N
28
27
26
25
33
34
35
Port Mitchell
NOBLE COUNTY, INDIANA NO. 33

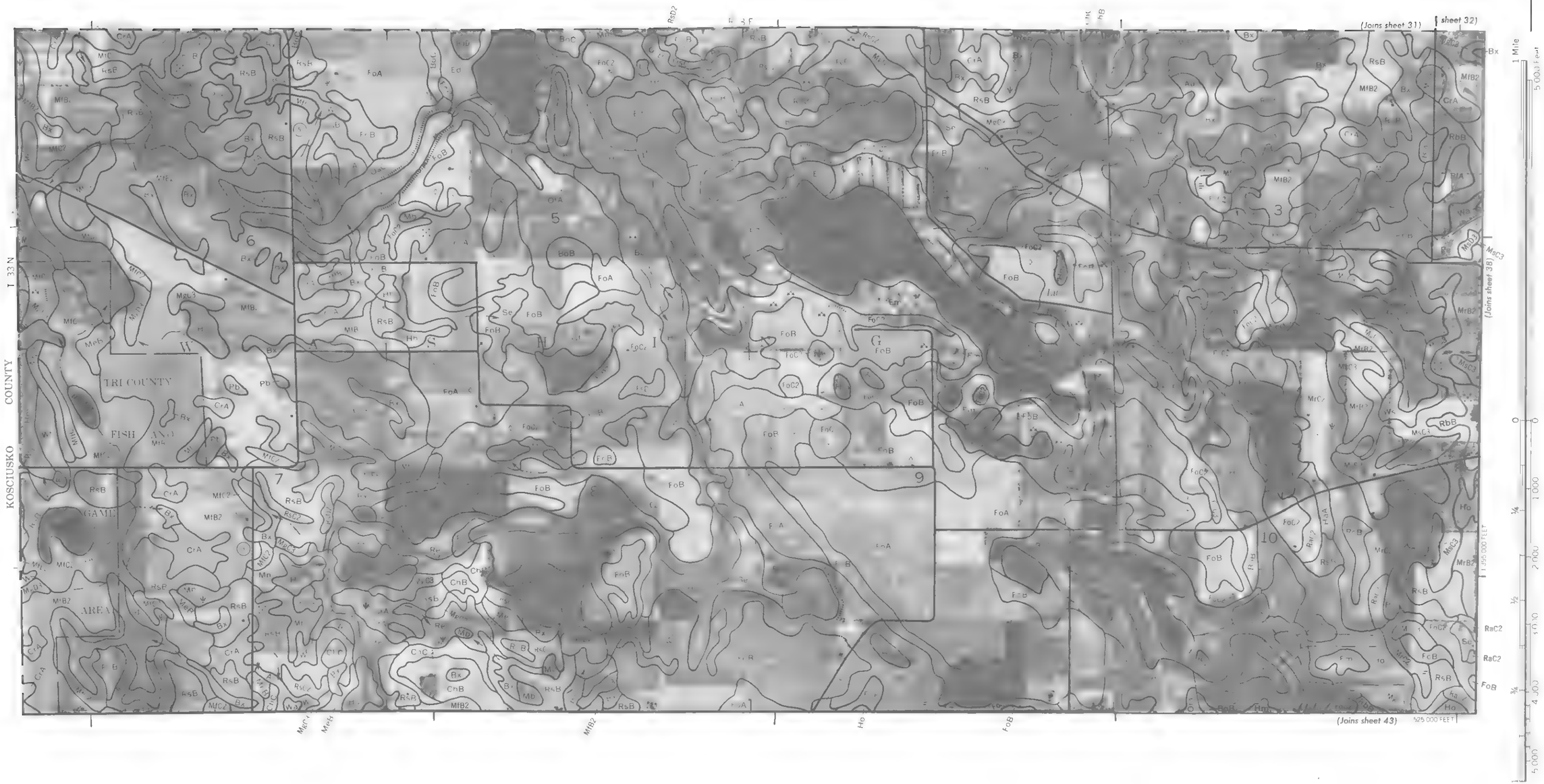


NOBLE COUNTY, INDIANA NO. 34



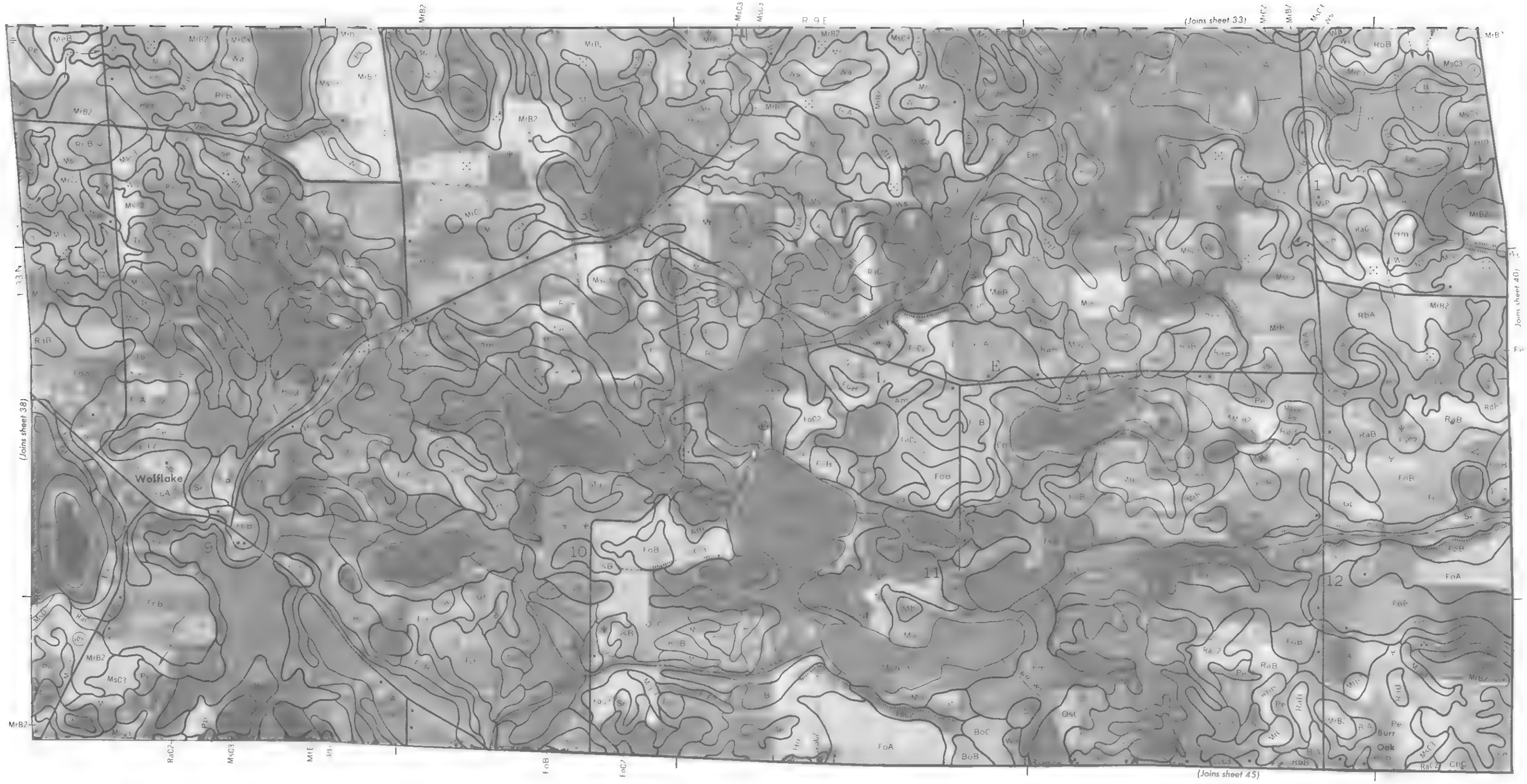
NOBLE COUNTY, INDIANA NO. 35


36
N
1 Mile
5,000 Feet
0
1,000
2,000
3,000
4,000
5,000
1/4
1/2
3/4
1
(Joins sheet 35)
(Joins sheet 30) To
(Joins sheet 42)
R 11 E
T 34 N
Avilla
DEKALB COUNTY
NOBLE COUNTY, INDIANA NO. 36

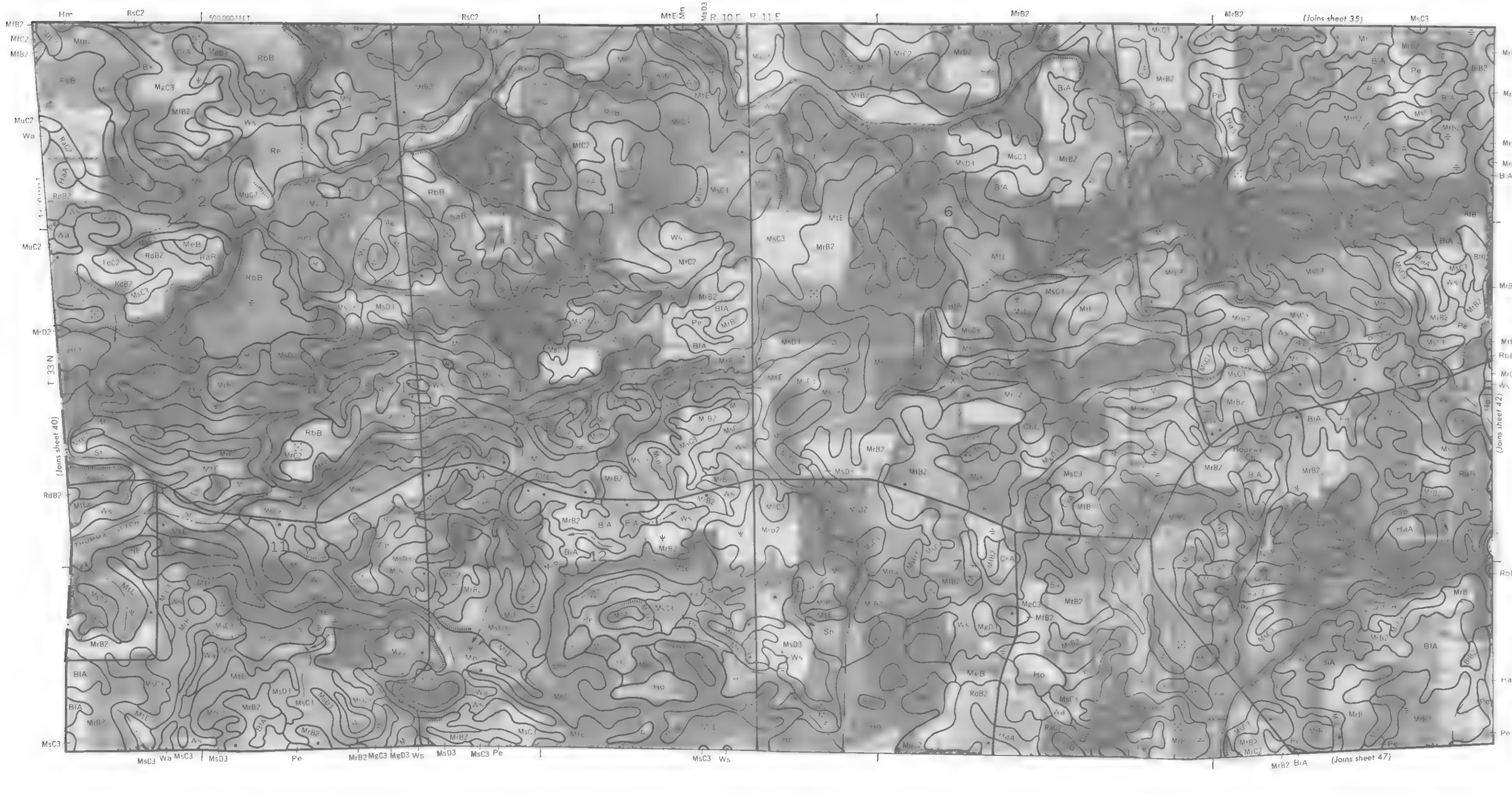


NOBLE COUNTY, INDIANA NO. 37

NOBLE COUNTY, INDIANA NO. 38


39
N
R 9 E
T 33 N
(Joins sheet 38)
(Joins sheet 33)
(Joins sheet 40)
(Joins sheet 45)
Wolflake
Burr Oak
5 000 Feet

NOBLE COUNTY, INDIANA NO. 40



NOBLE COUNTY, INDIANA NO. 41

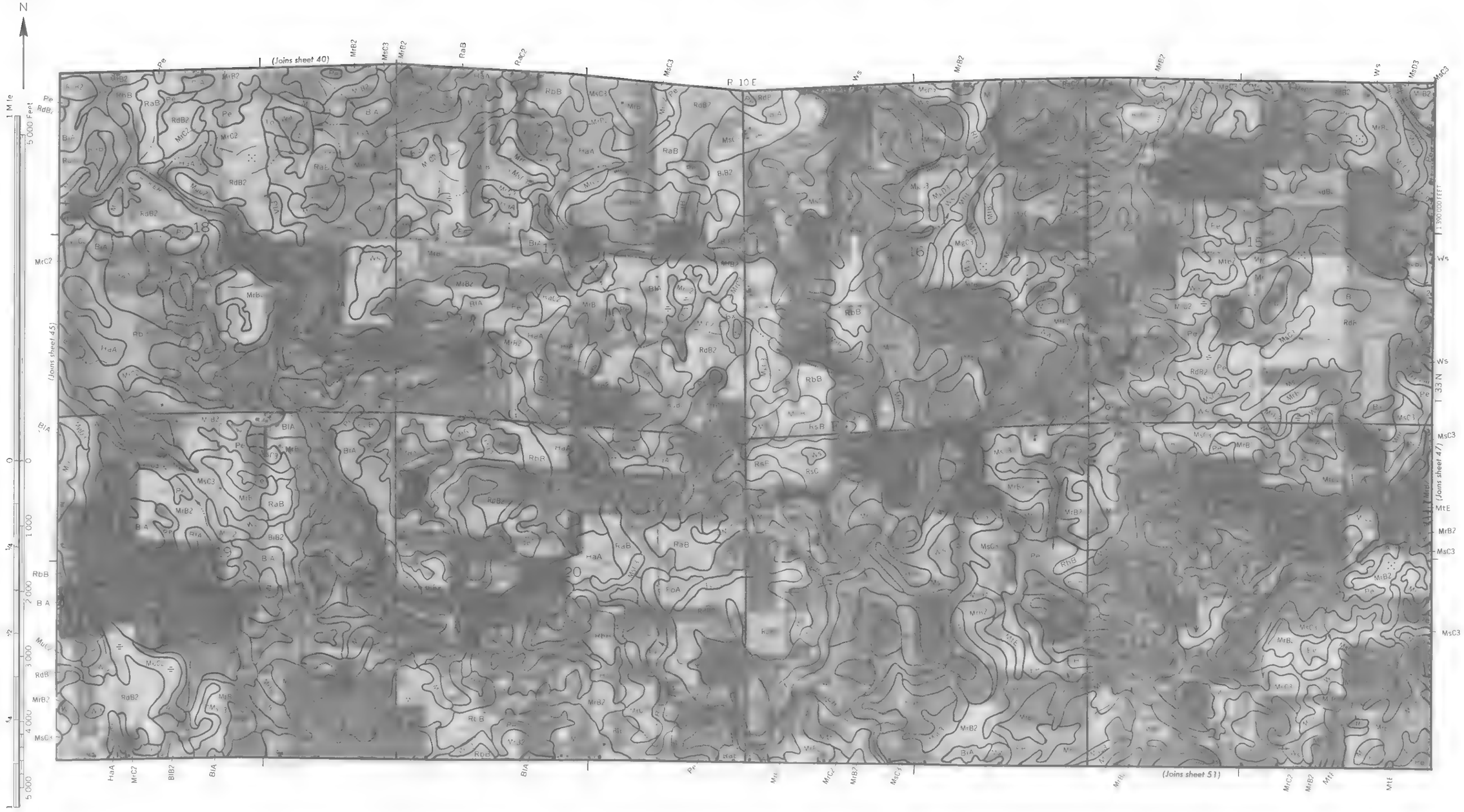

42
N
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 36)
(Joins sheet 41)
(Joins sheet 48)
R 11 E
T 33 N
DEKALB COUNTY
NOBLE COUNTY, INDIANA NO. 42

NOBLE COUNTY, INDIANA NO. 43

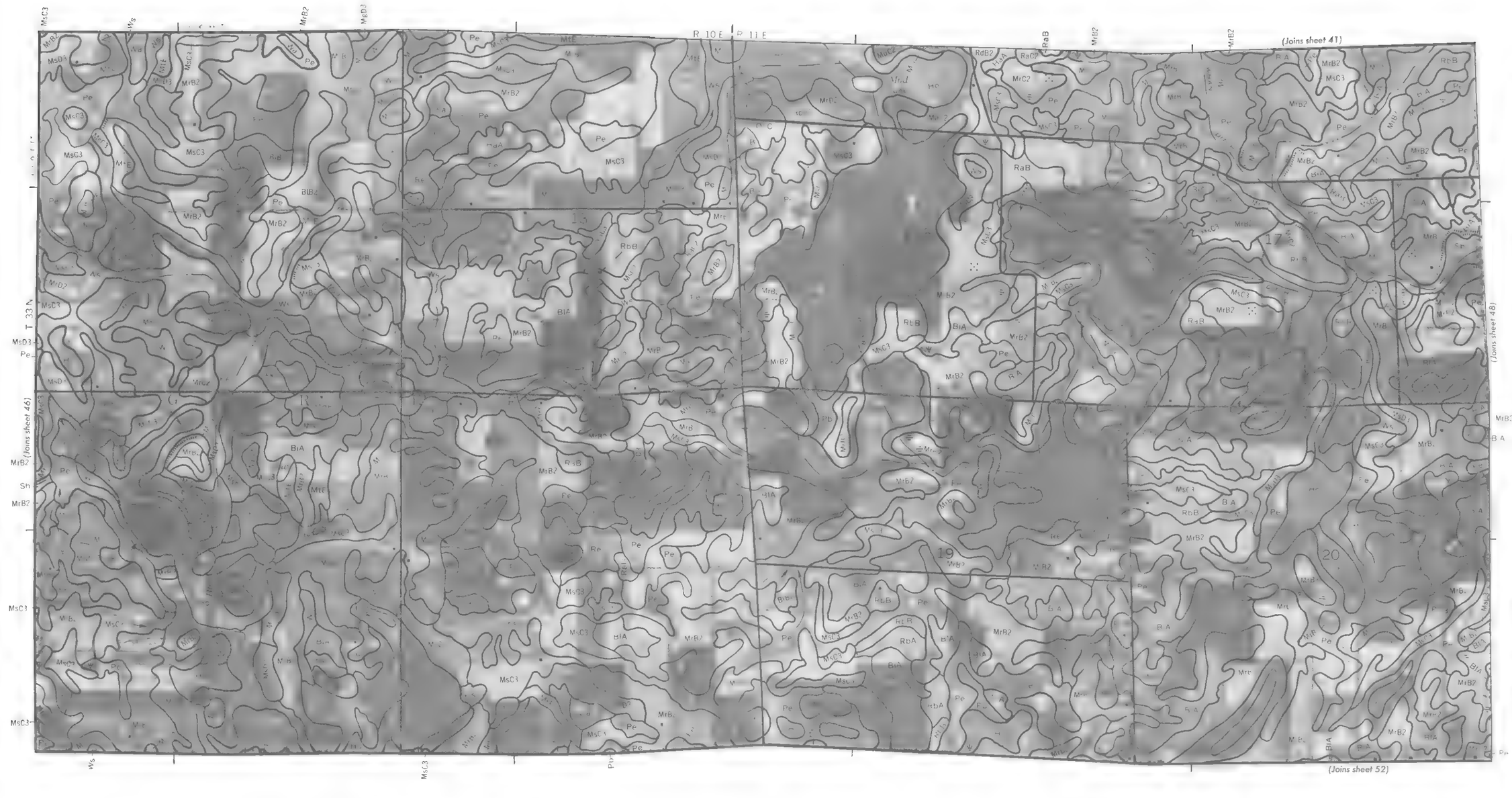
NOBLE COUNTY, INDIANA — SHEET NUMBER 43

NOBLE COUNTY, INDIANA NO. 44

NOBLE COUNTY, INDIANA NO. 45



NOBLE COUNTY, INDIANA NO. 46



NOBLE COUNTY, INDIANA NO. 47

NOBLE COUNTY, INDIANA NO. 48

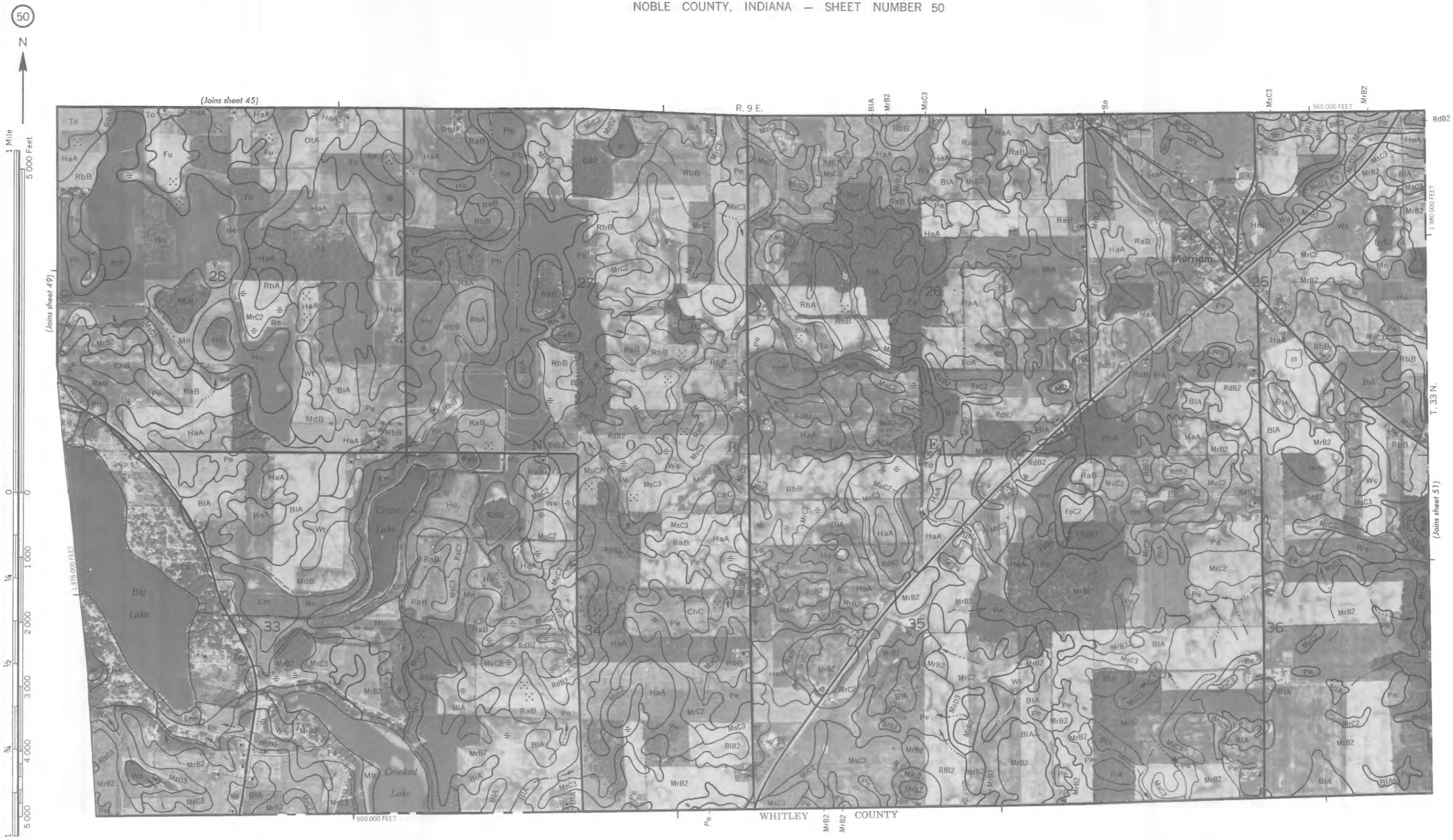
This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies

NOBLE COUNTY, INDIANA NO. 49

1 Mile
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet

N

NOBLE COUNTY, INDIANA — SHEET NUMBER 49

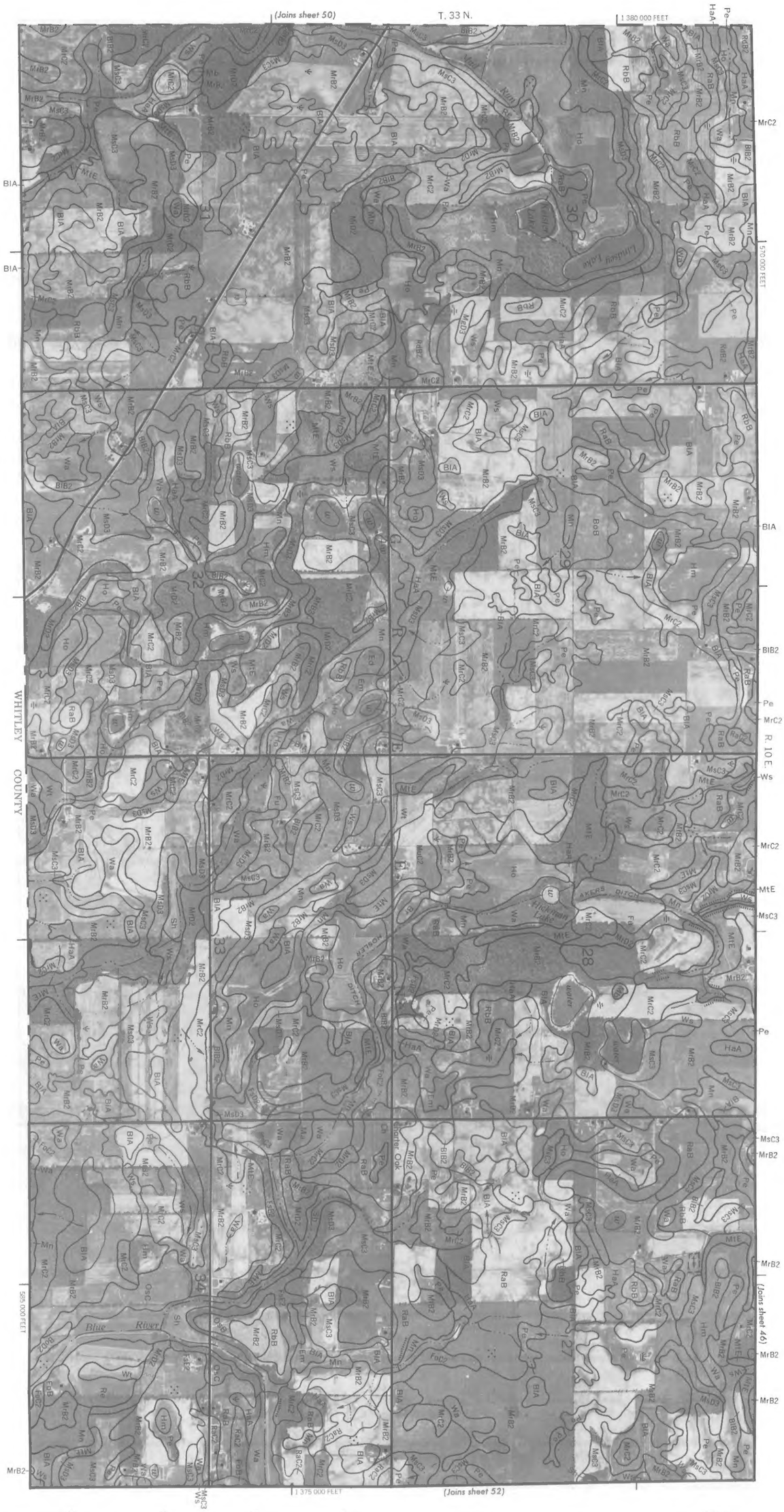


NOBLE COUNTY, INDIANA NO. 50

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

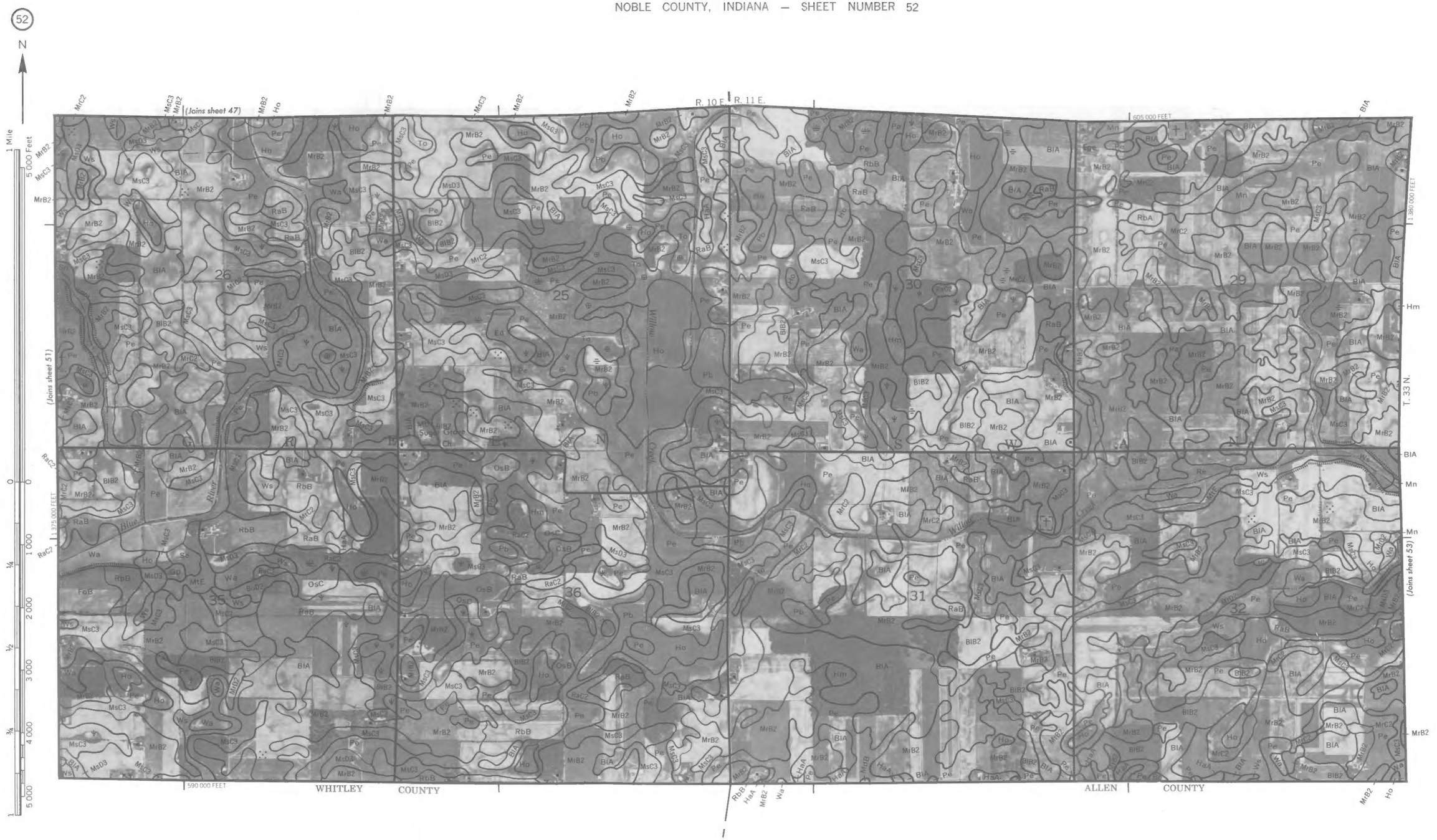
NOBLE COUNTY, INDIANA NO. 51



NOBLE COUNTY, INDIANA — SHEET NUMBER 51

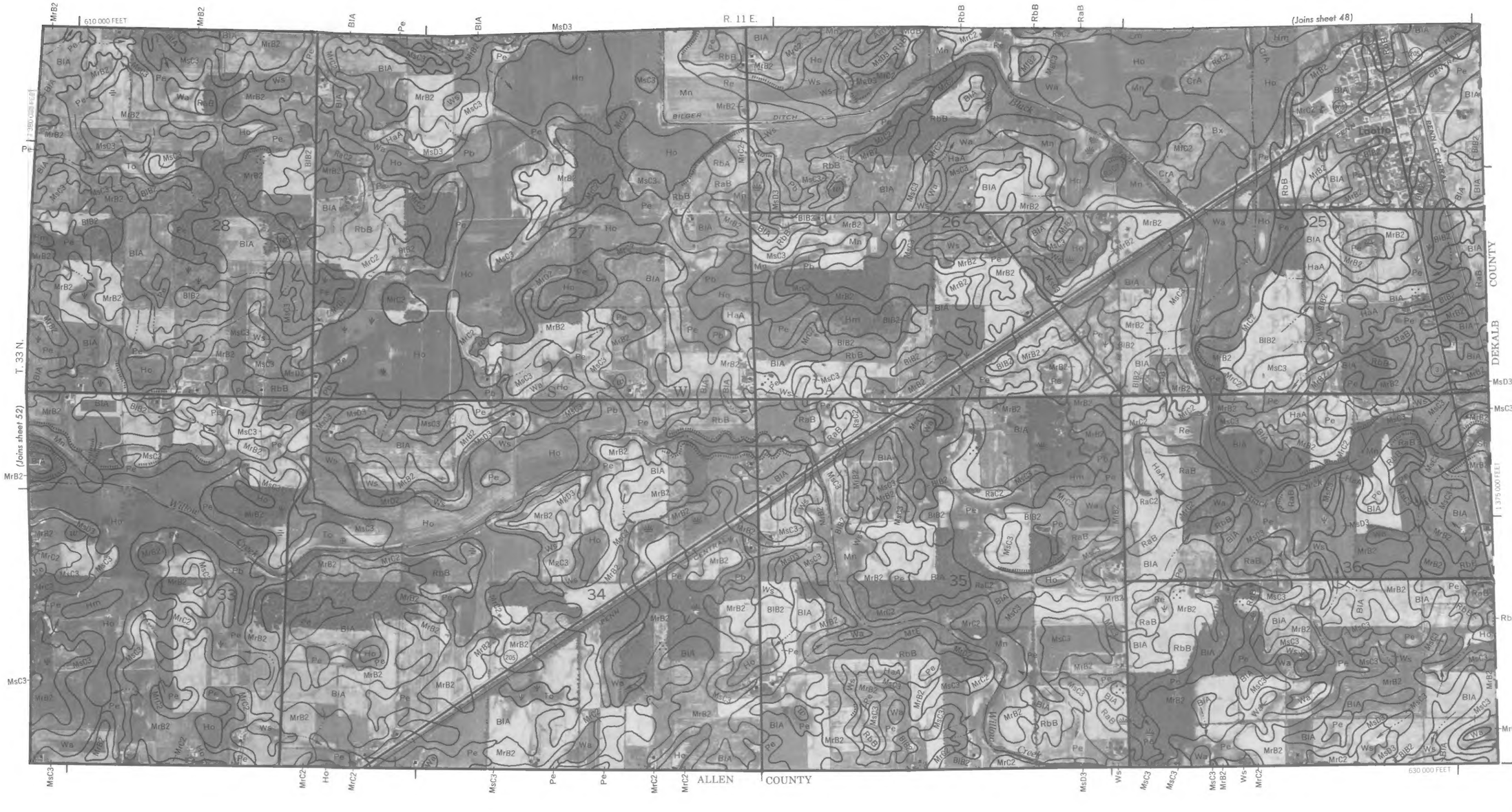
1 Mile
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet

N



NOBLE COUNTY, INDIANA NO. 52

This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



NOBLE COUNTY, INDIANA NO. 53